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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 88 — NEW YORK, FEBRUARY 23, 1922 — Number 8

The Shortest Code of Ethics

CONTRACTORS of a generation ago had the world's shortest code of ethics, according to Daniel A. Garber, who told the Associated Pennsylvania Highway Contractors recently that the old code was summed up in just two words: "Be slick." Today, contractors have a new conception of their responsibilities to employer and public, but they still can claim the record for brevity in their ethical code, which, Mr. Garber says has been amended to read: "Don't be slick."

"Standard" Paving Brick

QUESTION has been raised as to the interpretation of the word "standard" in connection with the recent action in simplifying the varieties of paving brick. Some fear that the word may be taken to mean that the conference which met in Washington on Nov. 15 declared that the retained varieties were all equally good from a technical standpoint. For ourselves we do not believe that this interpretation will often be made by engineers, though obviously it may be used by unscrupulous salesmen in urging particular varieties on the uninformed and particularly on non-technical councilmen and city officials. The term standard is used in two senses in American technical practice: as indicative (1) of a type or procedure that qualified experts have formally declared to represent the best practice and (2) of a type so largely used as to form the bulk of the manufacturers' product. It is in the latter sense that we refer to "standard" I-beams, "standard" cast-iron pipe, "standard" drain tile, etc.; and in distinction to this use of "standard," we have "special" I-beams, "special" pipe, etc. It is obvious that it is in this sense that the term "standard" was used by the conference on simplification of paving-brick variety and not in the sense that it gave equal technical value to the varieties retained.

Bad Steelwork

AS REPORTED in our accounts of the Knickerbocker Theater collapse the steel roof framing of the ill-fated structure did not cause the disaster by primary failure. But it was apparent from the first that the framing was defective in arrangement and contained many objectionable details. Subsequent study of the wreckage by the authorities has brought out more definitely how bad the steelwork really was. It lacked stability, it was stressed far beyond safe limits, and its details were shockingly slipshod. The fact is that all engineers who examined the ruins came away with wonder that the shoddy assemblage of columns and trusses, negligently tacked together, had not failed. Engineering instinct insisted that such work must condemn itself by breaking down, yet, flaunting sound principle, it seemed to have justified itself by surviving. Now, however, the fact is developing that the fear-inspiring weakness of this steel "structure" (save the mark!) did play a part in the disaster, a determining part. Of the many elements and details of the roof that were ready to fail, one was so terribly fatal in its wretchedness—we refer to the end joint of the main truss where it rested on its wall support—that, had it not crumpled up on the night of the great storm, it would surely have done so a little later, when the destructive stresses on the lower chord and gusset had concentrated a trifle more. The weakness of this part was not due to error or oversight, for it was of a piece with all the other bad engineering in the roof. Nor was it the product of incompetence, for the designer was able, we have reason to believe. It represents the inevitable outcome of the downhill course of departing from sound principle of design, of "getting by" with one job of slighted or skinned detail and thereby being tempted to another and another—in short, it is what the whole debasing system of bad engineering habit leads to. Steelwork is sturdy, and has a reserve strength that enables it to resist even severe abuse; but the engineer who presumes on this fact to excuse bad practice merely prepares for disaster.

To Weed Out Road Boosters

LEGITIMATE highway-improvement financing is making such heavy demands upon the public's pocketbook that a diversion of private funds into other channels than construction and maintenance of routes economically justified constitutes a menace to the good-roads movement. The public has made such a ready response to calls for money that the good-roads slogan has been seized upon by scores of road-boosting organizations as a means of supplying "easy money" to the promoters who head these bodies. At the present time there are somewhat more than 200 of these organizations which select highway routes for their boosting operations, give them a fine-sounding name, like the "Yankee-Doodle Highway," and then proceed to go out for money. Some of the funds may be used for leigtimate purposes of highway promotion, but the chances are that a large portion does no other good than to fatten the pockets of the professional road-boosters. The danger in the situation is that the public, once victimized by one of these booster organizations will withold funds from legitimate highway-development projects. With taxes of one sort and another constituting a heavy burden for all citizens, funds for highway improvement should not be dissipated in wildcat schemes instituted largely with motives of personal gain. Conditions in the road-boosting business —for it has developed into practically that—have reached a stage which has indicated to the American Automobile Association the desirability of a thorough weeding-out process. All good-roads associations, of course, are not open to charges of uselessness and dishonesty, but enough goats have mingled with the sheep to warrant a separation of the flock to the end that more money shall go into road-building and less into road-boosting.

Propaganda of Fact

THERE are trembling on the brink of disclosure—with some misgivings on the part of the planners—a number of campaigns to tempt the public into more active buying. They are of the variety made familiar by the "Buy Now" and "Let's Go" campaigns of some years back.

The efficiency of such efforts is very doubtful. The public is suspicious. Obvious propaganda leads it to question whether the efforts are not entirely selfish; there is apt, therefore, to be reaction rather than compliance. On the whole it seems best to let the usual processes of education take their course.

For practical results facts like the Bethlehem Steel Company's decision to go forward with improvements and extensions to cost $25,000,000 are far more potent than the generalities of a boom-and-boost campaign. Nor does the disapproval of blatant propaganda carry with it condemnation of efforts to get favorable factors before the public. Far from it. The public should be acting with intelligence. It cannot do that unless it knows the business situation. To show, for example, that building prices have materially declined is not a mere selfishness on the part of materials dealers, engineers and contractors, but is rendering a service to the public. Even then, however, there can be an unfavorable reaction if an impression of an effort to hurry the market is created.

We need propaganda—but propaganda consisting of a fair presentation of facts, and with the public's interest, and not solely the seller's, in mind.

Bonus Legislation and Industrial Revival

SOLDIER Bonus is occupying one of the prominent positions on the Washington political stage. It is truly a political question—or rather one of politics and of sentiment. The members of Congress are impressed with the volume of the soldier vote; the public, largely, looks with a soft heart on any proposal that favors the men who wore khaki. Examined critically, in the light of the justice of the proposals, the probable benefits to the veterans and the effect on the country's economic condition, the payment of a bonus, at the very best, is of doubtful advisability; in fact, we think the general opinion of those who would so examine it would be unfavorable.

We do not propose here to review the arguments for and against the bonus, but merely to repeat the suggestion so frequently made that the burdens the American people are carrying already constitute a very serious drag on American business. To increase that burden must further retard business revival. What the individual veteran may gain in dollars he will lose in deferred and less lucrative employment.

Potential economic dangers are so apparent that the proponents of the bonus have dropped the proposal to issue bonds to cover the cost, and have worked out alternative methods of compensation which will spread the cash outlay over many years. Even so, however, the immediate annual cash outlay will be large. Additional burdens on business will be inevitable. We have just removed taxes on railroad travel and freight shipments to stimulate business; now some would impose a tax on parcel-post shipments. We have wiped out excess profits taxes (as of this year's earnings), yet some bonus advocates want a 2½ per cent tax levied on undivided profits, thus curtailing the capital available for extension of industrial enterprises. In other words, to pay the soldier bonus we must again clap on the industrial restraints which we have only recently removed.

We believe that, calmly considered, the bonus legislation under present conditions is a mistake. We hope that statesmanship, not votes, will decide the issue at Washington.

Road Grading Costs Underestimated

GRADING probably offers more ways of losing money and is more generally underestimated by contractors than any other item of paved-road construction. These statements are especially true where the yardage moved is small, as is usually the case, particularly in the prairie states.

When road-yardage figures begin to mount and especially where isolated deep cuts or fills present themselves, the contractor takes notice at once and gives overhaul, classification, length of haul and all the other factors of the problem of earth-moving his undivided attention. If, however, there is only a skin cut of two or three thousand yards a mile, the tendency is to throw the item of grading in with the minor charges for construction without looking far into its character or cost. Safe practice would, of course, be just the opposite.

The high-cost operations in road grading are scarifying, shaping, ditching, slope dressing, grubbing, sod removal, replacing over-cut, etc., and where yardages are small these items dominate the unit costs. The price per yard of grading should, therefore, be greater for small than for large yardages per mile of road. This is an elementary lesson in earth-moving costs but the history of highway bids in recent years indicates that contractors have learned it poorly. In a measure the reason is that many of them have had experience in pavement laying rather than in earth moving, but more generally it is because few contractors keep separate costs of bulk excavation and of the grade-finishing operations.

Finishing is a large part of the cost of any grading operation and most highway grading requires a "sand-papered" finish. If contractors had the itemized costs of slope dressing and the other processes of road grading, which are not primarily true excavation, and had put the costs into their bids they would have less complaint to make about specifications which call for sand-papered grades.

Possibly, also, the price of sand-papering might bring home to highway officials its decidedly small value to the road.

A Challenge to Sewage-Works Engineers

A CHALLENGE to American and British sewage-works engineers is perhaps the best short characterization of T. C. Hatton's paper on centrifuges for sewage-sludge dewatering. The challenge lies first in Mr. Hatton's sweeping allegations that both British and American engineers have gone only or little more than half way in preventing a nuisance and menace from the liquid portion of sewage while almost neglecting like nuisance and menace from sludge. Secondly, Mr. Hatton, at least by inference, charges American and British engineers with negligence in sewage-sludge utilization and credits the Germans with doing much better. In his opinion, centrifuges may be used to de-

water sludge so it will become a commodity sought by the farmer and truck gardener.

If we rightly interpret the best British and American thought and practice, Mr. Hatton has gone too far in both these challenges. Certainly there has been much justification in giving first place to the liquid rather than the solids of sewage, whether considered as a mere nuisance or as a menace to health. As to sludge utilization, it has been a veritible will-o'-the-wisp for a half century. Recovering processes by the score, patented and unpatented, have come and gone and others are now at the front, but who can bring forward a commercial balance sheet that would warrant private capital investing money in any of these processes, new or old? At most, there has been and is now promised only some lessening of the cost of sludge disposal, with very few thorough-going data to show just what that lessening cost is. The activated-sludge process has promised most among recent processes in the way of sludge recovery for fertilizing purposes, but engineers await official word that the only large-scale dewatering plant yet built—the one contracted for several years ago at Houston, Tex.,—is yet in successful operation or that Mr. Hatton himself, after years of experimentation at Milwaukee, has solved the problem to his own satisfaction, even experimentally.

Nevertheless, Mr. Hatton's paper is a challenge that deserves the careful attention of sewage-works engineers, for eventually we must go on to better things in sludge disposal and with every year's increase in population, and consequently in food and fertilizer demand, there is more need for recovering the fertilizing values in sewage, if that can ever be made economically possible.

Private Initiative for Public-Works Enterprises

FOR the past year or two activity in public-works construction has surpassed that in other fields of the civil engineer's work. With all this activity, little in the way of starting new improvements has been done except in highway-building. A beginning has been made, but only a beginning, in catching up with the deficit in maintenance and extensions accumulated during the disturbed conditions of the last eight or nine years.

Public-service improvements—such as meet real needs and are wisely planned—are among the most potent means of increasing the efficiency of the community's life. There are many, very many, that wait to be carried out in every part of the country. Yet, aside from high-pressure highway construction, little more than routine betterment work is going on. There are good reasons for this. They lie in the tremendous difficulty of public financing, in the cumbersome and inefficient procedures required for organizing large public undertakings, and in similar hindrances. Perhaps the most formidable obstacle is the absence of live initiative from public planning; but, in addition, even when a promising plan is suggested, and even when it receives the support of both government and the general public, it has a rough road to travel before it reaches concrete realization, and all but the most persistent supporters are discouraged by the prospect. The underlying factors of this condition are such as will continue in operation for a long time, and it can hardly be doubted, therefore, that for years to come many urgently needed public improvements will remain dormant, if they depend upon public action.

These circumstances create a new opportunity for private engineering enterprise. Public works for which there is a true demand can be built by private initiative, and built rapidly and efficiently, where their construction by public machinery is substantially impossible. Such enterprise is entitled to welcome and encouragement, since its effect is to raise the level of the community's working efficiency.

Private enterprise formerly was the controlling agency in the construction of public improvements. It was enterprise of the purely exploitational type—that of the railway and canal companies, let us say, or later of the street railways. We have progressed rather far beyond the conceptions of that day. New ideas prevail as to the obligations entailed by public service, conceptions that indeed are considerably ahead of what is represented in many of our surviving semi-public corporations. Public-works enterprise by private initiative today must be organized to carry out with thoroughness its public-agency functioning, as the condition of receiving public support. But there is no reason for believing that such organization would hamper the enterprise or render its success doubtful.

Proper organization and satisfactorily fixed relations with the public being provided for, two decisive advantages of private public-works enterprise call for notice. The are *first*, the allocation of cost of service to those directly benefited by it, admittedly an ideal condition; and, *second*, the guarantee against unwise or unproductive enterprise offered by the fact that financial returns are a controlling consideration. These two advantages speak so obviously for themselves that fuller discussion is hardly needed to justify them. But a word on the first may be appropriate.

Tolls—or service charges—are better than taxes. This truth is recognized in many kinds of public service. Thus, free water supply has been advocated and has been practiced; but none have fought the practice more consistently than the staunch supporters of public water supply. Moreover, they have fought the flat rate and the nominal charge, and have come to stand determinedly for true service charges. By their own efforts, arguments marshalled in convincing manner have proved that every device for throwing public services upon the general tax rate is undesirable. It is these very arguments that speak for a method of public-works construction by which charges for any special service are placed upon those who use the service, as against methods that would further swell the heavy burdens of taxes and public debt.

Were it practicable, perhaps even today the toll system would be invoked to support our road maintenance; an obvious effort to reach the same end indirectly may be seen in the steadily evolving principles of our motor license system. Direct toll collection is not practicable for roads. This does not signify, however, that the system may not be applied to a bridge.

The interesting bridge project for the Hudson River Highlands, sketched in this issue, is a case in point. It gives a tangible basis for the discussion of questions that have long been in the air, and as the most prominent recent proposal of public-works construction by private initiative, it directs attention anew to the possibilities of this method and should help in encouraging its application to other needed public improvements.

Building a Rib-Arch Concrete Bridge in Arkansas

Fourteen 146-ft. and Two 212-ft. Arches with Girder Span Approaches, Form Concrete Structure 3,173 ft. Long—First Highway Crossing of the Arkansas River—At Fort Smith, Ark.

By C. A. Prokes
Resident Engineer, Missouri Valley Bridge & Iron Co.,
Fort Smith, Ark.

ARCH centers were special features in constructing the nearly completed Arkansas River bridge at Ft. Smith, Ark. Methods of erection and the way of building out 146 ft. steel centers to carry a 212-ft. arch, were uncommon. The pier work was unusual in plan and in some of the construction methods. Incidentally the bridge is one of the largest concrete structures of the southwest, being 3,173 ft. long and containing over 20,000 cu.yd. of concrete reinforced with 784 tons of steel.

A view, Fig. 1, of the nearly completed bridge, looking from Oklahoma toward Arkansas, indicates the principal structural features. Besides an earth fill approach 2,000 ft. long on the Oklahoma shore, there are 3,173 ft. of concrete structure as follows: Arkansas retaining wall approach, 203½ ft.; twelve girder spans, 498½ ft; fourteen 146½-ft. arch spans, 2,047½ ft., and two 212½-ft. spans, 424½ ft. The overall width is 41 ft., comprising a 28-ft. roadway and two 6½-ft. sidewalks. The highest point of the roadway is 76 ft. above mean low water.

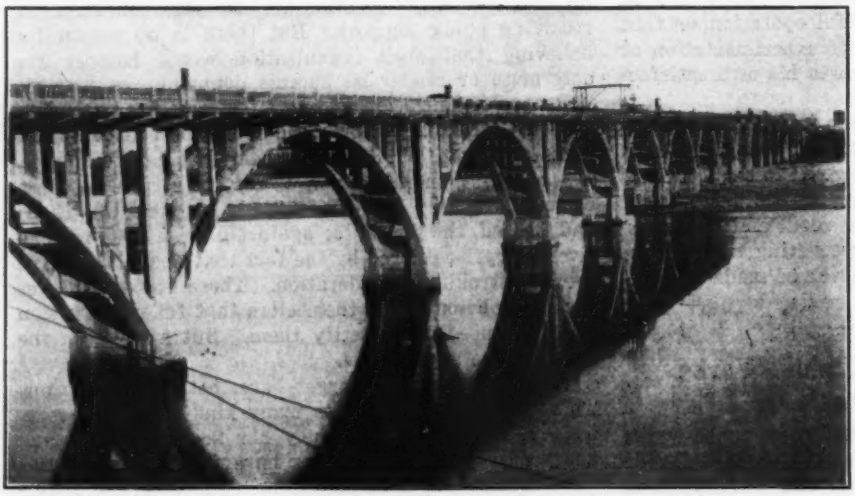


FIG. 1. ARKANSAS RIVER HIGHWAY BRIDGE NEARING COMPLETION AT FT. SMITH

A 1:2½:5 concrete mixture was used in the bases of all piers, the railing concrete was a 1:1½:3 mixture, and all the remaining work was of 1:2:4 concrete. The arch ribs were designed for a live-load of two 49-ton street cars on a single track; 100 lb. per square foot on the remainder of the roadway; 80 lb. per square foot on the sidewalks, and 25 per cent impact. The floor slab and girders were designed for the live-load of a 15-ton road roller, or 150 lb. per square foot; 100 lb. per square foot on sidewalks, and 25 per cent impact. The maximum allowable stresses used in the slabs and girders were 600 lb. per square inch concrete compression, and 16,000 lb. per square inch tension in steel. The allowable compression in concrete in the arch ribs, including dead and live loads, rib shortening and temperature stresses for a range of 40 deg. F. was 800 lb. per square inch.

All the piers, including the abutment piers, have solid rectangular concrete footings, varying in height from 14 to 16 ft., and resting on a hard shale river bottom. From this rectangular footing the two abutment piers rise vertically in front, and on an incline in the rear, to take the thrust from the arch ribs. There are no wing walls on the abutment piers. The other fifteen piers above the footing, have a section like capital H, Fig. 2. The sides of the H which take the thrust are at the spring line, 8 x 14 ft. for the two longer spans, and 6 x 9 ft. for all the others. The web section is 48 in. wide. The two side sections are battered 1¼ in. per foot in height, from pier base to spring line.

The arch ribs for each of the fourteen 146-ft. 3-in. arches are 4 ft. 6 in. wide, varying in height from 3 ft. at the crown to 5 ft. 6 in. at the haunch. On the two 212-ft. 3-in. arch spans the arch ribs are 6 ft. 6 in. wide, with a height 3 ft. 6 in. at the crown and 7 ft. at the haunch. The small arch ribs are braced laterally by four rectangular concrete beam struts to each half span, and the large arch ribs have three beam struts per half span. (Fig. 1.) The spandrel columns are rectangular, 11 ft. 3 in. apart horizontally, and support the cross beams, or floor beams, 15 in. wide, which carry the roadway slab. The sides of the spandrel columns are battered ½ in. per foot, downward from the floor beam, in the width only. At each pier a T-shaped column 43 ft. 3 in. high, Fig. 2, connects the top of the pier with the deck. The floorbeams are 48 x 15 in. in section, between the columns, and are cantilevered from the column to the sidewalk edge to carry the sidewalk. The roadway and sidewalk are divided longitudinally into panels 11 ft. 3 in. long by these floorbeams, thirteen per small span and eighteen per long span. Each small span has four transverse expansion joints of ½ in. elastite, which cut the deck work into sections averaging 38 ft. long. The long spans also have four expansion joints, averaging 51 ft. apart. The sidewalk slab is 4 in. thick, the roadway slab is 8½ in. thick, and two track girders at the center, and one railing girder on each side are the only longitudinal beams under the roadway.

Four river piers and one abutment pier on the Arkansas shore, were built in open cofferdams of light steel sheetpiling by M. M. Elkan, contractor, Macon.

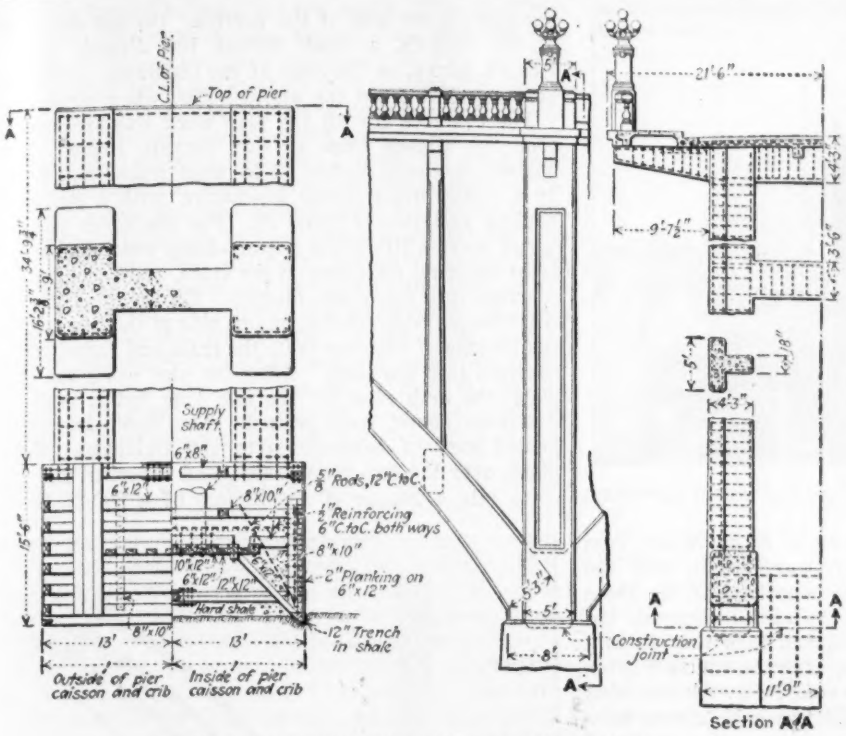


FIG. 2. TYPICAL PIER AND CAISSON DETAILS

Ga., who suspended work in April, 1920. In July, 1920, a new contract to complete the 75 per cent of unfinished work was awarded to the Missouri Valley Bridge & Iron Co., of Leavenworth, Kan. The remaining twelve river piers were then sunk by the pneumatic process, six piers through 32 ft. of sand and gravel on the sand bar, and the other six piers through water for one-third of the sinking depth. The twelve piers were sunk in 4½ months, averaging 7½ actual working days for sinking one pier, working three 8-hour shifts. An air compressor on the Oklahoma shore furnished air through a 4-in. iron pipe, carried across the river on a pile and timber tram trestle, and the maximum distance for piping was 2,000 ft.

The side walls of the caisson cribs were 6 x 12 in. timbers laid horizontally, and held together with ¾-in. iron drifts, 30 in. on centers, and covered on the outside with 2-in. friction planks, placed vertically, (Fig. 2). The cutting edge timber was covered with a 6 x 6 x ½-in. iron angle on the bottom, to act as the cutting edge of the pier. On the sand bar, the caissons were built directly on the ground, while in the river, they were built on a platform, supported by wood piling, and when built, were lowered to the river bed with six 2-in. screw jacks.

The most difficult pier work was where one of the steel pile cofferdams, that had to be abandoned on account of high water, was discovered almost full of sand and leaning downstream, distorted and at an angle, and partly in the site where the new pneumatic pier was to be sunk. Several 1-in. cable slings were passed through holes in the tops of the steel piling under water, by a diver. These cable slings were attached to wire rope rigging of double and triple blocks, fastened to the adjacent finished pier and the combined effect of several heavy dynamite blasts under water, and pulling on the piling, swung it aside so as to clear the pier site.

The steel falsework for each of the fourteen 146-ft. 3-in. arch spans consisted of one steel truss under each of the two arch ribs, with a pin connection at the center. These two trusses, when in place, were diagonally and laterally braced with rods, have a span of 136 ft. from back to back of shoes and are 46 ft. high. There was 7½ in. of oak blocking between the back of the truss shoe and the face of the concrete pier. The shoes rested on a 12 x 12 in. oak cap, supported by four 12 x 12 in. posts, on the top of the pier footing, and held to the side of the pier with bolts. The top chord of the trusses, on a radius 10 in. smaller than the intrados of the arch ribs were parallel to the arch rib bottom, thus requiring only 6 x 8-in. joists on edge, with 2-in. lagging on top of the joists, for the bottom form of the arch rib. The 6 x 8-in. joists were set perpendicular to the axis of the bridge, spaced 30 in. apart and held in place with ½ x 4-in. lag screws through the top chords of the trusses.

On the two 212-ft. 3-in. arch spans the clear distance between the face of piers, is 198 ft. The same steel centering was set in the center of the span, with each shoe resting on a cluster of nine wooden piles. With this set up, there was a clear space from the face of the concrete pier to the back of the truss shoe, of 31 ft. The falsework, therefore, consisted of the three steel trusses, braced diagonally and laterally, with the space between the top chord of the trusses and the intrados of the arch ribs built up of timber posts, caps and stringers, Fig. 4.

A layout was made on the floor of a barn hay loft, near the site of the work, of the arch ribs, the steel trusses, etc., on a scale of 1½ in. per foot, then the proper size stringers, posts, caps and sills for the design, were located on the layout. From the layout, full sized templets were made with the proper lengths, bevels and daps in the posts, sills and caps, and also the intrados curve on the joists for the arch rib. From these templets, all the timber was framed on the ground, properly marked, then erected in place and fitted together. This framing of all the timber before erection was a great saving in carpenter work.

The three steel trusses for the two long spans were erected in half sections. Three half trusses were assembled on pile bents on a level with the truss shoes, laterally and diagonally braced, then raised as one piece, by using two sets of four triple 14-in. iron blocks, Fig. 5. From each set of four triple blocks, there was one lead cable ⅝ in. in diameter leading to a two-drum hoist, which raised the three half trusses as one piece, by winding both engine drums simultaneously. The triple iron blocks were lashed to four 1-in. cable slings, rest-

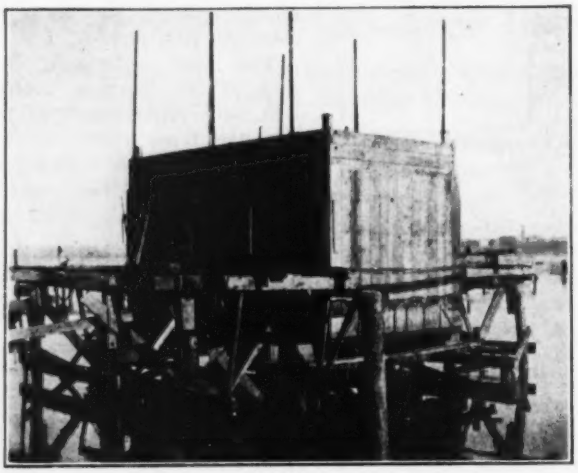


FIG. 3. CAISSON ON PLATFORM READY TO BE LOWERED

ing on a heavy timber bent, about 35 ft. above the truss shoes, this giving the necessary purchase to start the load of 25 tons, upward. After one half of the three steel trusses was raised and the cables clamped, the other half was similarly raised, and then the pin connection at the center was made. For the twelve shorter spans of 146 ft. 3 in. where the steel falsework consisted of only two complete trusses, the two half trusses were similarly raised in one piece, but the rigging consisted of four sets of one double and one triple blocks.

Plant for Concrete Work

A timber-trestle service railway was maintained across the two channels of the Arkansas River, respectively 570 ft. and 900 ft., during the construction of the piers. This tram track was 6 ft. above mean low water and was washed out by flood waters four times within six months, during the construction of the piers, but each time the piling and timber were salvaged by being held by wire rope. The tram track carried a 4-in. air pipe line from the compressor plant on the Oklahoma shore to the sand bar, which could be tapped at any pier site during the pneumatic sinking.

All sand and gravel for concreting was pumped out of the Arkansas River within a mile of the bridge site, delivered in barges to the Oklahoma shore and tested for the proper proportion of sand and gravel and then unloaded with a stiff-leg clamshell derrick, into a storage pile on one side of the derrick. On the other side of the derrick, a small mixing bin directly over a 1-cu.yd. mixer, on the edge of the Oklahoma shore, was kept supplied from the storage pile, when concreting.

The concrete for all the pier work was transported over the timber tram in two 1-cu.yd. bottom dump buckets, mounted on two 36-in. gage trucks and drawn by a 10-ton dinky steam locomotive, with a maximum hauling distance of 2,000 ft. For the river piers, a barge derrick lifted the bottom-dump concrete buckets from the cars, delivered on the tram, and deposited the concrete into the piers, directly. On the sand bar, an A-frame portable derrick, on one side of the track, lifted the buckets of concrete from the tram and deposited the concrete into the piers. After the pier work was complete, the arch ribs for the two long spans, near the Arkansas shore, were poured. The dinky locomotive hauled cars of concrete from the Oklahoma mixing plant, over the two river trams, and deposited the concrete into a hopper at the bottom of a 200-ft. tower,

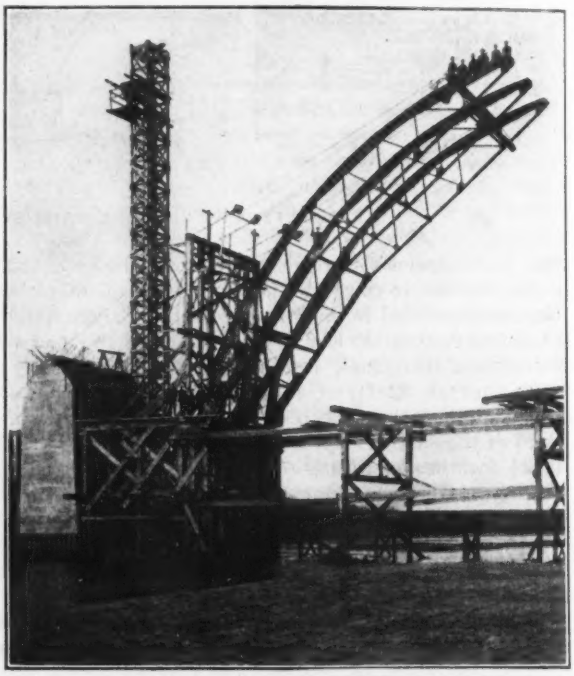


FIG. 5. RAISING STEEL CENTERS FOR 212-FT. SPAN

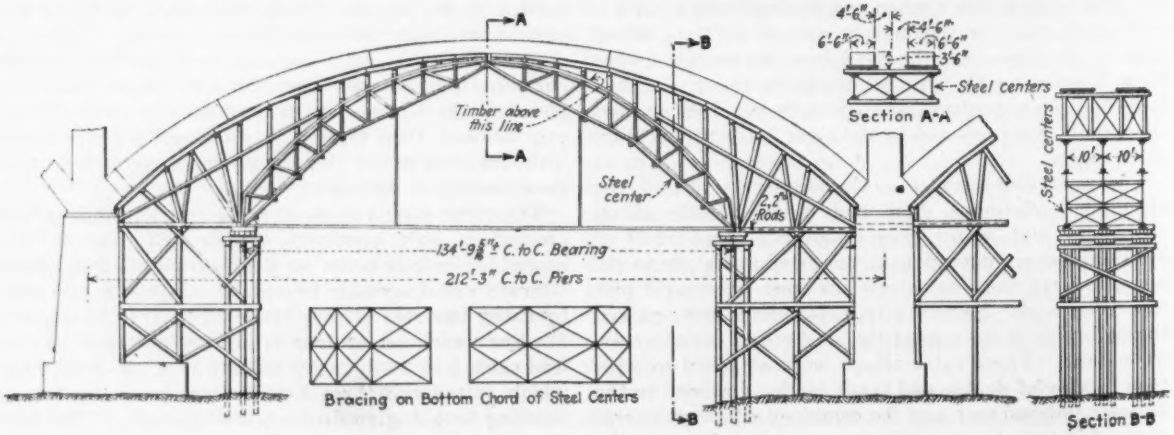


FIG. 4. STANDARD ARCH CENTER BUILT OUT FOR LONGER SPAN

centrally located between the two spans (Fig. 4). From the tower, the concrete was spouted into the arch ribs in four different pourings as shown in Fig. 3. The first pouring being adjacent to the haunches, the second adjacent to the crown, the third pouring covering the crown, and the last pouring being made at the haunches.

After the long arch ribs were poured, the river tram was abandoned and removed, and all the superstructure concrete above the tops of piers, was transported over an overhead tramway, resting on the forms for the arch ribs, and erected over the center line of the bridge, with its track 52 ft. above and parallel to the tops of the piers. The concrete in the 14 small arch ribs was poured in two operations only, of 215 cu.yd. and 16 cu.yd. respectively. The first pouring each time of 215 cu.yd., extended from a bulkhead 4 ft. from the haunch at the spring line, to the opposite bulkhead, similarly placed. This allowed the necessary settlement and shrinkage of about 97 per cent of the concrete in the full arch ribs, and 48 hours later, when the timber bulkheads were removed, the remaining 4 ft. of arch rib at the four haunches was poured.

The superstructure concrete was elevated in a 100-ft. tower at the Oklohoma shore, spouted 100 ft. to the center line of the bridge into two 1-cu.yd. cars, drawn by a gasoline tractor on a single 36-in. gage track. The tram track for the superstructure work was 4 ft. above the finished concrete roadway of the bridge, was maintained until all the superstructure concrete was in place, and after dismantling, the 8 x 8-in. holes in the 8-in. floor slab, through which the tram posts passed, were filled with concrete.

The original contract was awarded to M. M. Elkan of Macon, Ga., in February, 1919, for $537,000, for the entire work, but in April, 1920, work was suspended and the contract breached. In July, 1920, the contract to complete the unfinished work was awarded on a percentage fee basis. The structure will be ready for traffic about March 1, 1922, and the total cost will be approximately $850,000. The bridge was designed by Messrs. Hedrick & Hedrick, consulting engineers, of Kansas City, Mo., with J. M. Robinson, resident engineer. M. L. Wagner was superintendent and C. A. Prokes, resident engineer for the Missouri Valley Bridge & Iron Co., contractors.

Ban on Highway Advertising Signs

Advertising signs of all kinds are prohibited on state highways in California, according to the ruling of the California Highway Commission, and when found thereon are immediately removed by maintenance forces. While this policy keeps the right-of-way of the state highways free from obstructions, it does not prevent construction of billboards on adjacent private property.

Recently Kings County passed an ordinance prohibiting the erection of advertising signs on the county highways of that county and traffic officers have been instructed to remove all signs that remain on roads after a certain date. This action probably will be followed by other counties, as there is a growing sentiment against the disfiguring of highways with advertising contraptions.

The Farm Bureau centers in Butte County and in other sections of California are taking up the subject and it is quite possible, the commission believes, that sufficient sentiment will be aroused before the next legislature to make it possible to pass a general law prohibiting the disfigurement of the landscape by commercial appeals.

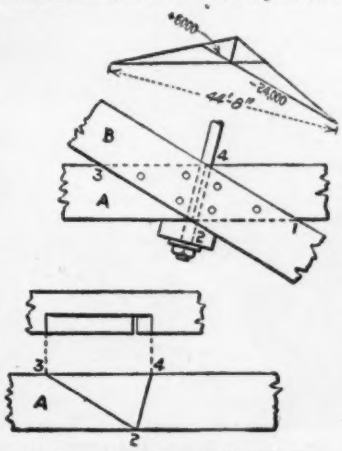
Hook Joint for Timber Chord of Scissors Truss

By David C. Coyle
Gunvald Aus Co., Consulting Engineers, New York

Ordinarily a wooden scissors truss is used only for short spans, and the stresses occurring at the intersection of the bottom chords, being small, are easily carried by bolts. The special detail shown herewith was made necessary by the unusual size of the truss, which has a span of 44 ft. 8 in., and by the fact that it is exposed, and must have no unsightly connections.

The stresses in the bottom chord are 24,000 lb. tension below the point of crossing, and 6,000 lb. above, making a total force at the joint of 30,000 lb. in each chord timber. If a pair of steel splice-plates had been used they would have required about thirty ¾-in. bolts; whether so many bolts would work together satisfactorily is more than doubtful. Splicing with 2-in. plank was rejected as unsightly.

Finally a form of hook splice was adopted which combines neatness with positive action and sufficient strength. The total thickness of the joint, for two 6 x 8-in. chord timbers, is 9 in., so that each timber is 1½ in. off center. The top and bottom chords are framed flush at the end connection, and above the crossing the bottom chord is tapered to the point where it enters a mortise in the top chord. By cutting this taper from one side only, the required bend is obtained to bring the tapered end on center. To make the joint the chord-timber *A* is cut on its inner or near face on the lines 2-3 and 2-4, removing a triangular block 2½ in. thick. Piece *B* is cut exactly the same (*not* opposite hand). When assembled, the two pieces hook together on the surface 2-4, which is very nearly perpendicular to the grain and to the line of stress. Surface 2-3 need not be accurate. The compressive stress on surface 2-4, which is about 8 x 2½ in., amounts to 1,500 per sq.in. Part of this surface is cut by a hole for the 1¼-in. rod, but as this area is enclosed in 3 in. of wood and firmly bolted against splitting, it seems fair to count the whole projected area as bearing load. The net tensile section of 3½ x 5¾ in. (2 bolts out), carrying 23,000 lb. (1,000 lb. deducted as load carried by first bolt), is under a unit stress of 1,240 lb. per sq.in.



TIMBER SCISSORS TRUSS, AND SPECIAL JOINT OF BOTTOM CHORD

Waterproofing a Leaky Reservoir at Nashville, Tenn.

Leakage Through Masonry Walls and Old Concrete Floor Necessitated Extensive Repair and Watertight Lining

A LINING composed of two layers of gunite with an asphaltic burlap membrane between them is the means adopted for waterproofing the masonry walls of a leaky reservoir at Nashville, Tenn. The membrane was extended over the concrete floor and covered with 4 in. of poured concrete. Both gunite and poured concrete were provided for in the specifications, the unit prices leading to the use of the former in the walls and the latter on the floor. Fig. 1 is a view of the waterproofing work in progress.

Water from the Cumberland River is pumped to a gravity reservoir of 50,000,000 gal. capacity on Kirkpatrick Hill, at an elevation of about 308 ft. above low water in the river. This reservoir is formed by 34-ft. walls of limestone blocks laid in natural cement, and in the middle of the wall is a vertical core of natural cement concrete about 15 in. thick. In plan the reservoir is oval, 603 x 463 ft. at the top, with a partition wall on the minor axis, as shown in Fig. 2.

Leakage has occurred through the bottom and walls since the reservoir was completed in 1889. A natural cement concrete floor was provided originally, but the water escaping through the bottom softened the earth and clay seams in the limestone rock so that in November, 1912, a section of the wall of the east basin collapsed. After rebuilding the broken section, the entire inner surface was covered with concrete applied by the cement gun, and new concrete floor with asphalt membrane was placed. At some later period the gunite was given an asphaltic coating applied by mopping. The construction, accident and repairs were described in *Engineering News* of June 16, 1888, p. 484; Nov. 14, 1912, p. 922, and May 6, 1915, p. 849.

Leakage again became evident in 1916, and in 1919 the city commissioners appointed a board of consulting engineers consisting of George W. Fuller, Leonard Metcalf and J. N. Chester. Investigation showed that thorough repair of the reservoir was necessary and plans were prepared under the direction of the engineers. These included not only a waterproof lining but the underpinning of the walls with concrete at points where leakage had affected the foundation. No lining was applied to the partition wall.

Work was started in the east basin, which had been empty for some time on account of the leakage. The first proceeding was to scrape from the wall the ¼-in. asphalt coating. Then the old gunite, which in some places had not adhered properly, was removed by pneumatic chipping hammers, which also dressed the rock-face masonry to a regular surface. Large projections were knocked off with sledge hammers and chisels. This work was done by men on suspended platforms and the dressed surface is shown at the left in Fig. 1.

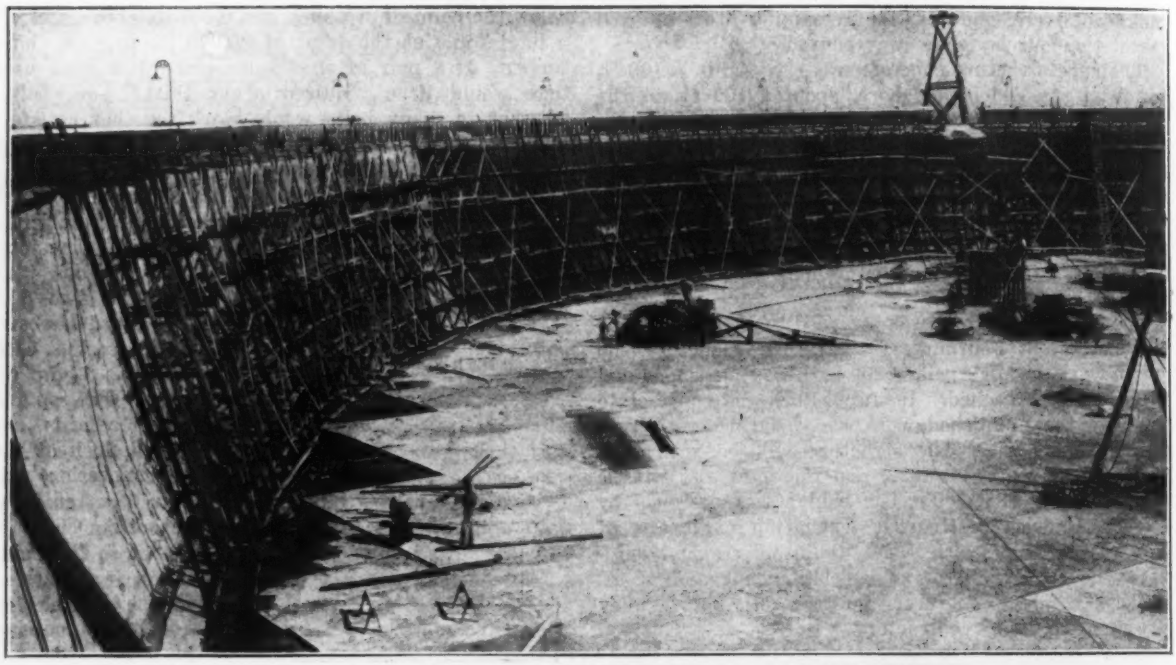


FIG. 1. LINING MASONRY RESERVOIR WITH GUNITE AND ASPHALT

Three rows of 1¼-in. holes were then drilled by pneumatic drills, one row about a foot below the coping, one about half way down the wall and the third near the foot. In these holes, 6 in. deep and 36 in. apart, railway spikes were grouted with a projection of about ¾ in.; to which were fastened horizontal ½-in. reinforcing rods. Galvanized wire netting of 4-in. mesh was attached to these rods, being placed in vertical sheets 54 in. wide, wired together at the 4-in. laps. The sheets were straightened by pulling them through a set of rolls.

Gunite was then shot on the wall at 60-lb. pressure, giving an average thickness of 3 in., encasing the wire mesh and forming an even surface. Sheets of burlap were hung against the surface and kept damp for 24

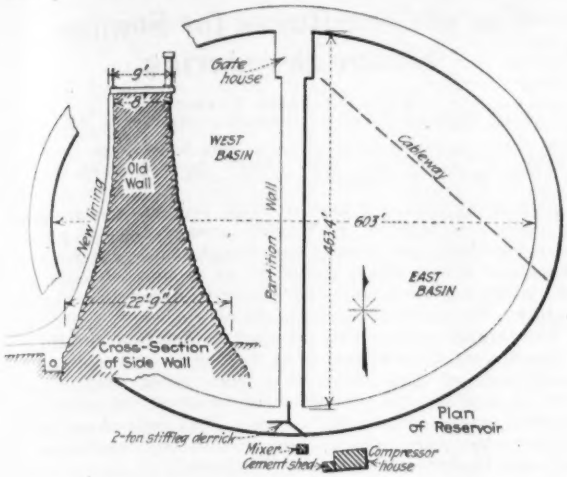


FIG. 2. PLAN AND SECTION THROUGH WALL OF RESERVOIR

hours, to prevent the gunite from setting too rapidly. As fast as the gunite became set and dry it was given a paint coat of asphalt. Sheets of asphalted burlap were then applied and mopped in place, the sheets overlapping so that the entire wall was covered with a three-ply membrane from just below the coping to a connection with the floor membrane. A coat of asphalt completed the membrane.

To carry the wire mesh for the outer or protective coating of gunite, holes 6 in. deep and 36 in. apart were drilled just below the coping and sloping downward. Into these were grouted the hooked ends of ½-in. rods extending down to the floor. When the wire mesh had been attached to these rods, a second 3-in. coat of gunite was applied, extending from the underside of the coping to the floor. Details of the lining are given in Fig. 3, and Fig. 4 is a view of the completed lining on the side wall, with the unlined partition wall at the right.

Test of Adhesion.—To determine the adhesion of gunite to the asphalt, a vertical concrete wall was covered with a membrane as used in the reservoir. Against this was placed a frame 1 ft. square and 3 in. deep, this being filled with gunite which was allowed to set for two weeks (see Fig. 5). A 550-lb. load was then suspended

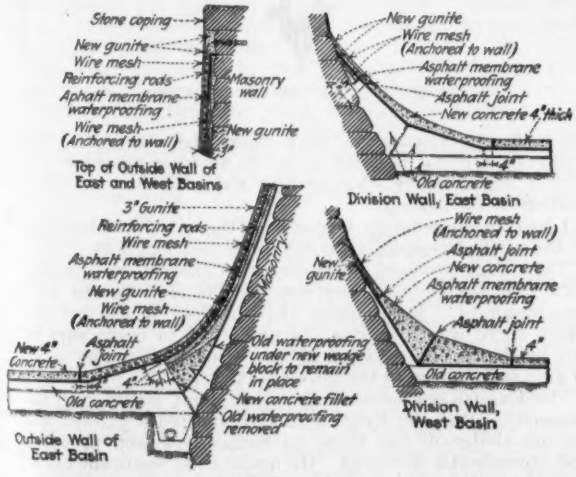


FIG. 3. DETAILS OF WATERPROOF LINING

from the gunite block at 10 a.m. and at 3 p.m. the block had slipped down ¾ in. A heavy storm prevented further observation, but next morning the block was on the ground and the membrane had sagged. A similar test showed that with a load of 200 lb. per square foot there would be no movement of the gunite on the asphalt.

Wall Concreting Plant.—Three air compressors were used to operate the chisels, drills and three cement guns. Water was pumped from the west basin. The dry mixture of sand and cement for the guns was prepared in a continuous mixer and elevated to a bin from which it was taken by a tilting bucket and handled by the derrick hoist shown in Figs. 2 and 4. This bucket dumped its contents into a chute supplying a hopper on the floor, from which it was conveyed to the cement guns in wheelbarrows. A scaffold was erected for about 75 per cent of the length of the wall (see Fig. 1), to permit of continuous operation of the three stages of the new lining. As fast as the outer covering of gunite was placed the rear sections of the scaffold were removed and re-erected to close the gap.

Floor Reconstruction.—Before laying the new floor, the upper wedge block around the edge of the old floor was removed and concrete was filled into the old drain

FIG. 4. WALL LINED AND CONCRETE FLOOR BEING LAID

trench and above the floor, forming a notch or recess as a footing for the first layer of gunite on the wall (see Fig. 3). This arrangement formed a smooth curve leading the membrane from the wall into the floor. After the old concrete floor had been cleaned, it was covered with a membrane composed of three layers of hot asphalt and two layers of burlap. Over this was laid the 4-in. protective covering of 1:2½:5 concrete, poured in place to form slabs 16 ft. square, as shown in Fig. 4. Hot asphalt was poured into the 1-in. joints between the slabs. This concrete was carried up at the sides to make a smooth junction with the gunite lining of the walls.

A cableway for handling material ran from a 55-ft.

FIG. 5. TEST OF ADHESION OF CONCRETE TO ASPHALT-BURLAP MEMBRANE

tower outside the reservoir, one end being anchored to a deadman and the other to a pipe in the floor under the gatehouse (see Fig. 1). A ½-yd. mixer adjacent to the tower delivered the concrete to a bucket which dumped it into a hopper supplying buggies which distributed the concrete over the floor. A portion of the reservoir with wall lining and new floor completed is shown in Fig. 4.

This repair work was carried out under the direction of J. N. Chester, one of the consulting engineers; W. W. Southgate, city engineer, and George Reyer, superintendent of waterworks. A general contract was let to W. S. Rae, of Pittsburgh, Pa. The waterproofing membrane was placed by the Ryan Sales Co. (agents for the Barber Asphalt Co.), Nashville, Tenn.; the concrete floor by the Gould Contracting Co., Nashville, Tenn., and the gunite by the Cement Gun Construction Co., Chicago. Work in the east basin was commenced July 1, 1921, and completed Sept. 1. After this basin had been filled with water, the west basin was emptied and cleaned of mud. Lining this basin was commenced Oct. 25 and completed by Jan. 1, 1922.

Stream Pollution Notice to Engineers

Under a law which went into effect in July, all plans for sanitary, land drainage and river improvement works in Illinois require approval by the State Department of Public Works and Buildings in regard to outlets into streams. A notice to this effect has been issued by the Division of Waterways of this department, since this provision of the law is not generally understood by engineers. There has been an impression that plans for sewerage and sewage treatment require only the approval of the State Department of Public Health, but if the outlet is to a stream a permit from the Department of Public Works must be obtained. Further, plans for drainage districts must be submitted to this department for approval, in order that outlets and stream improvements may be so arranged as to provide adequately for future demands of enlarged districts, instead of merely meeting present or local conditions.

Use of Centrifuges for Sewage Sludge Dewatering

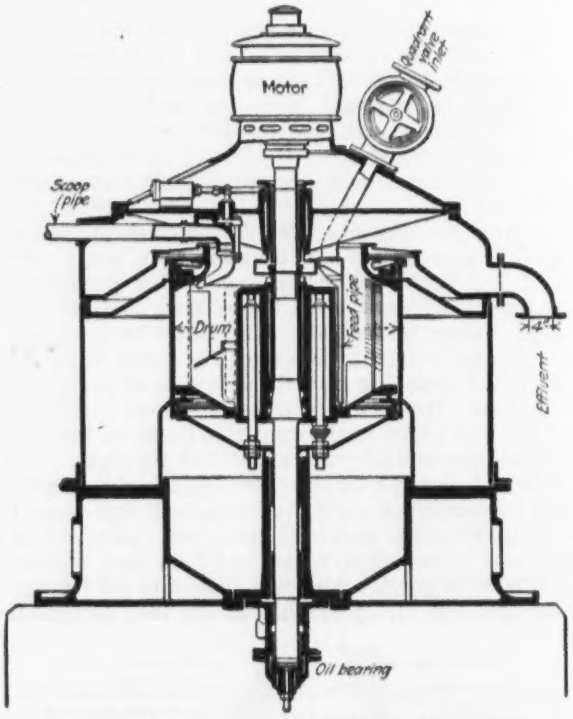
By T. Chalkley Hatton
Chief Engineer Sewerage Commission, Milwaukee, Wis.

Slightly condensed from a paper read before the Sanitary Section of the American Public Health Association, as printed in the *Journal* of the Association for November, 1921.

FOR many years—in fact up to the present—sludges produced by many of the English sewage disposal plants were deposited upon ground and ploughed in. After a few seasons of this practice, the tracts of ground set aside for this purpose became sour and unable to digest the organic matter. They were, therefore, abandoned.

The largest sewage disposal plant in England, the Birmingham plant, is now lagooning the sludge, monopolizing a large tract of most excellent ground which could otherwise be used for the production of foodstuffs of which the country stands so greatly in need. This method not only destroys the real value of the ground but constitutes a nuisance to the immediate neighborhood.

To sum up my impressions after a recent visit to many of the sewage disposal plants of England: There was



CROSS-SECTION OF CENTRIFUGE

none (except disposal at sea) where the disposal of the sludge was being handled so as to avoid a nuisance. In fact, it was creating a far greater nuisance than the clarification of the sewage.

I had an opportunity to compare the relative advantage of the methods employed in Germany and England.

The sludge problem, my observation showed, was studied with painstaking care and considerable skill by the German engineer. Recognizing that he had a product for which there was a market, he proceeded to make sure of this market by preparing and delivering his product so as to give satisfaction to the ultimate buyer.

The English engineer, on the other hand, starts with the assumption that the English farmer and truck grower will not use sludge in any form, no matter how well prepared and conveniently delivered. He ignores the requirements of his potential customers and produces his sludge in a form

best suited to himself. It is to be regretted that the American engineer has adopted the same negative point of view.

Modern agricultural chemistry shows that all sludges produced by sewage disposal plants contain sufficient fertilizer value in the form of nitrates (ammonia and humus) to warrant their use by the farmer or small truck gardner, provided the cost of handling is not too great. That the sludges produced from plain sedimentation may be profitably used by the agriculturist when the wagon haul does not exceed five miles, and providing the sludge contains not more than 75 per cent moisture, was demonstrated by the Agricultural Department of the late Imperial German Government as far back as 1912. The German Government from that time on prepared and distributed literature instructing farmers in the most approved ways of using sludge as a fertilizer.

What has been the result? Hamburg, Hanover, Frankfurt-on-the-Main and many other German municipalities are disposing of their sludge to the surrounding community so effectually as not to have a dozen wagon-loads left on hand any one night. In fact, the demand is so great that each customer is given his own day in the month when he must come for his apportionment, for which he pays a certain sum fixed by the government. While this sum is not sufficient to meet the cost of dewatering the sludge, it defrays at least a part of the expense. More important is the fact that the sludge nuisance is eliminated.

German Accomplishment

Now how has Germany accomplished what none of the rest of the world has been able to achieve? (1) By preparing its product to meet conditions under which the consumer can handle it; (2) by educating the consumer, through national and local government bureaus as to the value of the product and the best methods of using it. As a result of these two important services, a market for all the sludges produced has not only been found but is being extended more rapidly than the demand can be met.

That sludge which has been properly prepared need not look far or long for a buyer has been proved by at least one progressive English municipality. The city of Bradford, after extracting the excess grease from its sewage through filter presses, breaks up the cake by means of a disintegrator and thus finds a ready and profitable market for it among the fertilizer manufacturers. Notwithstanding the fact that Bradford's raw sewage is notoriously offensive, the neighborhood around the disposal works is free from unpleasant odors. This is due in part to the effective methods employed and in still greater part to the prompt shipment of the sludge to the consumer.

The Germans have prepared their sludges by partial dewatering through both filter presses and centrifuges and the sludges so treated are produced mainly from plain precipitation. The filter presses in use are quite similar to the types in common use in America from which about the same results are obtained. The centrifuges, however, are quite different from any the writer has heretofore seen, and are worth a brief description.

The machine is made by the "Hanomag" Works at Hanover-Linden, Germany. It was designed by Dr. ter Meer, director of the Hanomag plant, and George Froboese, his master mechanic. During the war, the American patents became the property of the Custodian of Enemy Property and were purchased by the Barth Engineering & Sanitation Co., of New York City, which changed the name of the machine to "Besco-ter-Meer."

Unlike most centrifuges, the machine is continuous and automatic in its operation and is devoid of all screens. It can be set to feed, discharge, post centrifuge and scoop at any cycle or combination without any manual control. It builds up its cake against a solid stationary plate and unloads it by dropping below this plate the depth of the bowl, the cake being thrown out of the bowl by centrifugal force into a chamber equipped with revolving scrapers which remove it to the point of discharge.

The important dimensions are as follows: Inner diameter of drum, 44 in.; drop of drum when discharging, 20 in. Depth of cake chamber to overflow zone, 24 in. Thickness of cake formed, 9 in. Operating oil pressure to support shaft drum and motor, 210 lb. per square inch. Total height of machine, including motor, 10 ft. Diameter of outer housing, 6½ ft. Weight of machine, approximately 10 tons, r.p.m., 1,000. Main drive motor, 35-hp. slip ring. Oil pump motor, 10 hp. Automatic control motor, 2 hp. Inlet wave designed to automatically control rate of feed.

Average records taken from two disposal plants where these centrifuges have been in use for several years will fairly illustrate the ability of the machine to dewater sludges from plain sedimentation. At the Herrenhausen plant, which treats the sewage from Hanover-Linden, amounting to 40 m.g.d., plain sedimentation only is carried out for clarification. The time of detention is two hours. Every two days one of the 12 sedimentation tanks is emptied and the precipitated solids, amounting to 70 per cent of the total suspended solids in the raw sewage, is run to sludge storage tanks.

This sludge, containing 96 per cent moisture, passes through a 9 m.m. mesh screen and into one of three 36-in. centrifuges, each of which delivers 11 cu.yd. of cake per hour, containing from 72 to 75 per cent moisture, the filtrate being returned to the raw sewage. The cycle of operation is four minutes, which embraces filling, centrifuging and discharging. Each machine requires a 25-hp. motor to operate and one man looks after the operation of all the equipment in the centrifuging house. Screw conveyors carry the cake from the machines to outside the building where it is loaded upon wagons and hauled away.

The sewage disposal method in use at Frankfort-on-Main consists of fine screening, ¾ hr. detention in sedimentation tanks and dewatering of sludge. Seventy-five per cent of the suspended solids are removed by sedimentation and these are removed from the tanks after about seven days, becoming quite septic before further treatment.

Eight 36-in. centrifuges are installed, each of which operates 1,200 hr. per month, producing 15,000 cu.m. of cake with 70 to 75 per cent moisture, or about 16 cu.yd. per hour, the filtrate being returned to the raw sewage. Each centrifuge is operated by a 15-hp. motor. Counting the screen, agitator and oil accumulator, each centrifuge requires 20 hp. to operate and one skilled laborer looks after all the plant inside the centrifuge house. The sludge is carried from the centrifuges by screw conveyors to direct-heat dryers where the moisture is reduced to 15 per cent.

Need for Sludge Reduction

During the war, the drying plant was cut out and the sludge cake from the centrifuges has since been conveyed by hand-pushed cars to a dump, from whence it is removed, as fast as deposited, by farmers and truckers who pay four marks per wagonload containing 2.6 cubic yards.

Compare this extremely sanitary method of disposing of sewage sludge, where no man handles it except to load the partially dried material in wagons, and where it cannot be seen from the time it leaves the sedimentation tank until it reaches the dump cars, with the present unsanitary and highly offensive method used in any of the modern plants.

It is the writer's opinion that the English and American engineers have failed to grasp the idea that satisfactory sewage disposal is not accomplished by merely treating the liquor so that the effluent shall not produce a muisance to the body of water into which it is finally discharged. It is no less essential that the sludge produced from such treatment should be so disposed of as to reduce to a minimum the nuisance and danger to workmen engaged at the disposal plant, and to the adjacent neighborhood.

The tendency in most disposal plants is to get rid of the sludge in the cheapest manner possible regardless of the temporary or permanent nuisance resulting. Until this tendency is overcome, the disposal of sewage will not prove satisfactory from the public viewpoint.

The writer believes from his experience in operating and viewing the operation of centrifuges in dewatering sewage sludges and water-laden solids in the industries that centrifuges of the proper type can be economically used in a great many disposal plants in this country and in Europe to displace the crude methods now practiced; that centrifuging will prove far more sanitary; that it will dewater the sludges so that they can be easily and profitably handled, thus creating a steady market for all produced.

FROM JOB AND OFFICE

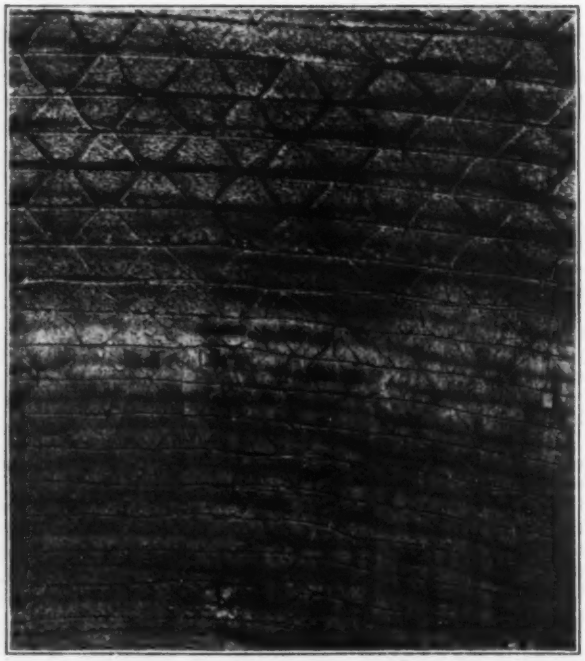
Hints That Cut Costs and Time For Contractor and Average Engineer

Drill Sharpener Used for Cutting Reinforcing Steel

CONSTRUCTION forces of the Southern California Edison Co. working on Big Creek power house No. 8, finding a Leyner drill sharpener available on the job, set it up in a convenient location in the material yard and used it for cutting reinforcing steel. Special dies were made in the blacksmith shop to adapt the machine to this purpose. The speed and convenience resulting from the use of the sharpener are said to have been factors in completing the job in record time. Bars up to 1 in. in diameter were cut in this way, a single blow of the hammer being sufficient to cut the small steel. Five or six blows were necessary for the heavier sizes.

Steel Standpipe Cleaned and Reinforced by Cement Gun

IN THE recent cleaning and repair of a high steel standpipe on the estate of Daniel Guggenheim, Port Washington, Long Island, a cement gun was used both to sandblast the corroded metal and to coat it with a mortar lining. The standpipe, which is 20 ft. in diameter and 80 ft. high, has been in service 20 years and had become so corroded that the structure had weakened considerably. Some of the rivet heads were almost entirely rusted away and the steel plate had become so thin that in cleaning the sandblast cut small holes through it.



EXTENT OF CORROSION SHOWN BY POCK MARKS—FIRST GUNITE COAT BELOW

The standpipe was first cleaned inside and out by sandblast, the cement gun being used as a sandblast machine. A ½-in. nozzle tip was used for this purpose instead of the standard tip used for placing the gunite. After the cleaning, 1-in. x 1-in. x ¼-in. angle clips placed on 18-in. centers were welded to the steel plates. A hole in the outstanding leg of each clip provided a means of fastening the heavy reinforcing wire mesh, used throughout. Although this mesh served as the principal reinforcing, where extra reinforcement was needed to restore the plates to their original strength, hoops made of ⅜-in. rods were used.

Gunite was then shot into place, forming a continuous sheet over the bottom and walls. No expansion or construction joints were used. The gunite was applied in three coats, each coat being permitted to set for from 12 to 24 hours. The thickness of the completed coat varied from top to bottom, the minimum thickness being 2 in.

The outside of the tank was sandblasted in the same way as the inside and then painted.

In placing the gunite a hollow octagonal scaffold with a diameter of about 18 ft. was used. It was suspended from the top of the standpipe by four double blocks and was handled quite easily by a crew of eight men.

Water was turned into the tank seven hours after the last coat of gunite had been applied and no leakage whatever occurred. The tank was then emptied and inspected for cracks or other defects, but none was found.

The contract for the repairs to the standpipe was executed by the Traylor-Dewey Contracting Co., Allentown, Pa. The work was completed in thirty working days.

Cap Stops Splitting of Treated Piles

DAMAGE to treated piles by the steam pile hammer was one of several kinds of trouble experienced some years ago in getting proper value out of these piles on the Atchison, Topeka & Santa Fe Ry., as noted in a paper read at a joint meeting of the Western Society of Engineers and the American Wood Preservers Association by A. F. Robinson, bridge engineer of the railway. Many cases were found where the heartwood had been broken loose from the sapwood. In the ordinary steam pile hammer the lower end, about 12 in. in diameter, projects through the driving lock and strkies the pile head. As a 12-in. circle has little more than 50 per cent the area of a 16-in. and only about 40 per cent that of an 18-in. circle, the blow from the hammer was being delivered into the piles over less than half the area of the pile head. Skin friction would hold the outer part of the pile and the hammer blows would drive the heartwood loose. In many cases the exterior ring of creosoted sap wood had been split vertically in driving, so that the piles were practically unprotected against decay. This trouble was overcome by means of a driving head or cap 18 in. in diameter, which rested squarely on the head of the pile and was so arranged that the blow from the hammer was distributed over the entire surface of the pile head.

Why Brickwork Estimates Vary

By Charles F. Dingman
Palmer, Massachusetts

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SEVERAL years ago a builders' supply dealer issued a catalog including a table giving the amount of materials required to make mortar to lay 1,000 brick. For a mixture of one part cement, one part lime putty and three parts sand, the catalog gave the quantities as: 0.36 bbl. lime, 0.75 bbl. cement, and 0.32 yd. sand. Use of these quantities was based upon ½-in. mortar joints.

I compared the table with the actual results reported from jobs upon which similar mortar and width of joint had been specified and found that the quantities used were as follows:

	Job 1	Job 2	Job 3	Job 4
Bbl. lime	0.94	0.65	0.50	0.81
Bbl. cement	0.53	0.57	0.37	0.19
Yd. sand	0.43	0.55	0.47	0.47

It will be noticed that none of the jobs completed furnished a very good check upon the figures given in the catalog. The small quantity of cement used on Job 4 is explained by the use of a local grey lime, rich in alumina, which produces a very strong mortar even when the major portion of the specified quantity of cement is replaced by lime.

The variation in the amount of lime used on the other three jobs is probably explained by the difference in the bulking capacities of the different brands used. For instance, three different brands show a production of putty of 2.50, 2.62 and 2.75 times the amount of dry lump lime, and authorities writing on the subject give an even wider variation. From the above, it would seem that, to get the actual proportions called for in the specifications, the quantity of dry lime used should never be more than 40 per cent of the quantity of cement used.

However the tendency is to exceed greatly the specified amount of lime whenever possible because it produces a smoother working mortar, which means a saving in labor cost of bricklaying even though the cost per cubic yard of mortar may be slightly increased.

Regardless of the amount of the cementing materials used, the quantity of sand used is what determines the quantity of mortar produced and the figures indicate a variation of practically 28 per cent between Job 1 and Job 2. Put in other figures, Job 1 used 400 cu.in. of sand per cubic foot of wall, while Job 2 used 510 cu.in.

If the sand contained 33 per cent of voids, 3 cu.ft. of sand and 1 cu.ft. of cement should produce 3 cu.ft. of mortar even if no lime were used; but, as the sand usually used will average from 40 per cent to 50 per cent of voids, the addition of a cubic foot of lime putty cannot increase the total volume beyond 3.70 to 3.80 cu.ft. In other words, the total volume of mortar cannot be over 1.27 times the amount of sand purchased. In actual practice, because of waste and other losses, the total quantity of mortar produced is very likely to be slightly less than the total amount of sand purchased.

So far all of our figuring has been upon the basis of twenty-one bricks per cubic foot. This means that the brick size must not be over 63.24 cu.in. to get the result obtained on Job 1, and 58 cu.in. to get the result obtained on Job 2.

In actual practice, we find estimators using an arbitrary figure for the number of bricks per cubic foot and that figure will range all the way from 18 to 22½, and, because they seldom know in advance what brick will be used, they figure almost every job on the same basis. This means that even if two men figured upon the same number of cubic feet of brickwork in a building, one might figure that he needed 100,000 bricks and the other might figure on 125,000, while the final quantities of brick and mortar materials bought for the job might not check either one. Brick actually used in the New England territory vary enough in size (from about 60 cu.in. to 76 cu.in.) to justify either estimate.

So much for the quantity of bricks themselves. The cost of the mortar materials is a very large factor in the cost of brickwork and may range from one-fourth to nearly one-half of the cost of the bricks.

If the quantity of mortar required could be accurately figured it should not be very difficult to determine the amounts of the ingredients and their costs. But, since the size of the bricks is not known in advance, the exact amount of mortar cannot be known in advance either, so common practice is to use an arbitrary figure per thousand bricks for each of the ingredients and these arbitrary figures vary greatly for the same kind of mortar.

Even if the amount of mortar per thousand bricks were determined accurately for a given size of bricks, it would only be absolutely accurate for a given thickness of wall. For instance, if a thousand bricks laid in a 12-in. wall require 0.55 cu.yd. of mortar, varying the thickness of wall would affect the quantity of mortar approximately as follows:

8-in. wall, 94%	0.51 cu.yd.
12-in. wall, 100%	0.55 cu.yd.
16-in. wall, 103%	0.565 cu.yd.
20-in. wall, 105%	0.58 cu.yd.
24-in. wall, 107%	0.59 cu.yd.

These differences are small, it is true, and on a small building would average up so as to balance one another, if costs were reported for a job having all 12-in. walls and those costs were used for estimating another one

This Issue Explains

A new use for a drill sharpener
The repair of a standpipe with a cement gun
How to keep treated piles from splitting
Why brickwork estimates vary
Spacing of mesh reinforcing with pipe grid
How to make large titles for plans and maps
How Arkansas drainage districts are surveyed
Some features of a heavy-duty cableway
How to clean pavements with motor truck exhaust
How to interest a foreman in specifications

having all 24-in. walls, the difference might be appreciable. If a cubic yard of mortar costs $12, then the mortar for a thousand bricks in a 12-in. wall would cost $6.60 and in a 24-in. wall it would cost $7.08. On 1,000,000 this difference would be $480, well worth taking into consideration.

The accompanying tables will be found helpful in estimating the quantities of materials required to make a cubic yard of lime-putty, cement and sand mortar and to compute the cost of mortar per one thousand bricks, the size of bricks and width of joints being known. Having determined the cost of a cubic yard of mortar and the quantity required, the cost of mortar per thousand bricks is readily ascertained.

TABLE I—QUANTITY OF INGREDIENTS PER CUBIC YARD OF MORTAR.

(In the proportions column, cement is given first, lime-putty second, and sand, third.)

Proportions	Barrels Cement	Barrels of Dry 180 lb. Basis	Lump Lime 280 lb. Basis	Cubic Yards Loose Sand
1–1–3	2.28	1.21	0.82	0.94
1–1–2	3.02	1.58	1.07	0.91
1–1½–3	2.28	0.61	0.41	0.94
1–1½–2	3.02	0.80	0.54	0.91
½–1–3	1.19	3.12	2.11	1.00
½–1–2	1.76	4.61	3.11	0.99
1–3 with 10% lime-putty	2.28	0.12	0.08	0.94
1–2 with 10% lime-putty	3.02	0.17	0.12	0.91

TABLE II—NUMBER OF BRICKS REQUIRED TO LAY ONE CUBIC FOOT OF WALL.

Average Volume of One Brick in Cu.In.	¼-in. Joint	⅜-in. Joint	½-in. Joint	⅝-in. Joint
60	23.7	22.4	21.1	18.6
61	23.5	22.1	20.8	18.4
62	23.3	21.9	20.4	18.2
63	23.0	21.7	20.0	18.0
64	22.4	21.3	19.9	17.8
65	22.2	21.1	19.8	17.6
66	21.9	20.8	19.6	17.4
67	21.6	20.6	19.3	17.2
68	21.3	20.3	19.0	17.0
69	20.9	20.0	19.8	16.8
70	20.6	19.7	18.6	16.6
71	20.5	19.5	18.5	16.4
72	20.3	19.2	18.2	16.2
73	20.0	18.9	17.9	16.0
74	19.8	18.7	17.7	15.8
75	19.5	18.4	17.5	15.6
76	19.1	18.2	17.3	15.4

TABLE III—VOLUME OF MORTAR, IN CUBIC YARDS, REQUIRED TO LAY ONE THOUSAND BRICKS.

(12-in. wall basis. Full joints.)

Average Volume of One Brick in Cu.In.	Cubic Yards Mortar Required— ¼-in. Joint	⅜-in. Joint	½-in. Joint	⅝-in. Joint
60	0.28	0.35	0.42	0.56
61	0.28	0.34	0.41	0.55
62	0.27	0.33	0.40	0.53
63	0.26	0.33	0.39	0.52
64	0.28	0.35	0.41	0.55
65	0.28	0.35	0.41	0.55
66	0.28	0.35	0.41	0.55
67	0.26	0.33	0.39	0.52
68	0.28	0.35	0.42	0.56
69	0.30	0.37	0.43	0.59
70	0.28	0.35	0.42	0.56
71	0.29	0.36	0.43	0.57
72	0.28	0.35	0.42	0.56
73	0.29	0.36	0.43	0.57
74	0.29	0.36	0.43	0.57
75	0.30	0.37	0.45	0.58
76	0.31	0.39	0.46	0.62

Some of the figures in Table III may be seen inconsistent at first sight but, by comparing these figures with those in the Table II and noting the volume of wall produced by one thousand of a given size of bricks, the apparent inconsistency will be explained.

Slag-Concrete Highway Mileage

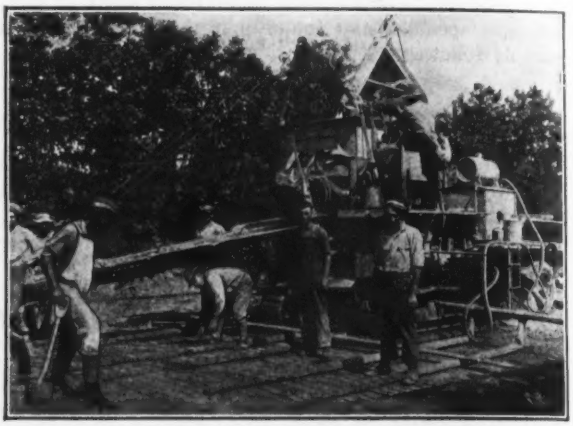
According to a report issued in January, 1922, by the National Slag Association, there are in service in the United States 132 sections of slag-concrete highway, totaling 212.65 miles in length, with an area of 2,392,899 sq.yd. The largest amount of construction of this type has been performed in Ohio, where 44 sections of slag-concrete highway, with a length of 91.87 miles and an area of 760,312 sq.yd. are in service.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Pipe Grid Behind Paver Spaces Mesh Reinforcement

REINFORCED-concrete paving slab was placed full depth in one operation on highway work on Long Island in 1921 by carrying the mesh reinforcement on a number of pipes trailing behind the mixer, as indicated by the illustration. The pipes were bent and hooked to a bar extending transversely across the mixer. They



PIPES PULLED BY MIXER SUPPORT REINFORCEMENT

were 3 in. in diameter and they held the mesh this distance above the subgrade until the concrete was in place to hold the reinforcement. The pipes, of course, were buried when the concrete was placed, but as the mixer moved ahead often, the concrete remained soft enough to flow in and fill the spaces left by withdrawing the pipes. Incidentally very good progress was made on this road. In 75 days worked, 47,290 lin.ft. of 20-ft. pavement were laid daily. Wm. J. Porter & Co., New York, were the contractors.

Making Titles for Maps and Plans

By Clair V. Mann

Head of the Department of Engineering Drawing, Missouri School of Mines and Metallurgy, Rolla, Mo.

MAKING ELABORATE titles for large maps or for cover sheets for engineering plans is becoming a lost art. To make old Roman, Egyptian or other letters in large size requires time and peculiar ability, neither of which is generally possessed by the average practising engineer. Though the writer is not an advocate of the general use of large or fancy titles, there are occasions when their use is necessary. In order to avoid tedious handwork, black gummed letters, such as appear on office doors, may be used to advantage. Use of them is also quick and inexpensive.

First, secure the desired quantity of letters to be used in the title. Then lay the title letters, properly spaced, on a sheet of cross-section paper and draw a vertical line through the middle of the space occupied by the letters. Mark a horizontal line upon which each row of words rests, and outline each word.

Then place over the cross-section paper a sheet of tracing paper, fastening one side of it to the drafting

FROM JOB AND OFFICE

For Contractor and Average Engineer

board. Transfer, in turn, each of the words from the cross-section to the tracing paper, sticking the letters in the positions marked from the cross-section paper beneath. The letters can be handled deftly with a pair of tweezers, and, with a little practice can be lined up and placed accurately and speedily. Proceed thus until the title is complete. By such a method there is produced a tracing from which may be made attractive blue-print covers for sets of plans.

Surveys for Drainage Districts in Arkansas

By O. G. Baxter
Baxter Engineering Co., Little Rock, Ark.

THE MAJORITY of drainage districts in Arkansas are located in the eastern part of the state, in the Mississippi River bottoms, with areas varying from 10,000 acres to 300,000 acres and averaging about 25,000. Most of the land is covered with timber or has been cut-over and has a heavy growth of underbrush and cane. The surface is broken by many lakes, sloughs, bayous and rivers, and the land is usually subject to overflow during the winter and spring.

In order to plan the survey intelligently the engineer must make a complete reconnaissance either on horseback or by walking. A boat can be used to advantage in some districts. The number of camp parties to be used is governed to a large extent by the time available before the wet season. Each camp party consists usually of the following members: Chief of party, 1 draftsman, 3 instrumentmen, 3 rodmen, 6 axemen, 1 teamster and one cook. When two or more camp parties are used, a field engineer is required to supervise the entire survey.

Equipment for each camp should consist of a cooking and dining tent, three sleeping tents and an office tent. Kitchen utensils, cots and mosquito bars are also a part of the equipment. The malaria mosquito does its work mostly at night and is not such a nuisance as the ordinary mosquito, so that it is possible for a man to sleep without being disturbed by the attack of the malaria mosquito. For this reason the chief of party should see that each man has a mosquito bar and that he uses it.

Personal equipment of each man should be limited to a bed roll and necessary toilet articles that may be packed within the roll when camp is moved. The moving of camp is generally left to the cook and teamster after the men have packed the equipment before starting on the day's field work. Camp is moved as the work progresses in order that the maximum distance to the point of work will not be more than four or five miles. It is rarely that the team and wagon can be used to advantage in transporting the men to the work, as roads are scarce and are usually winding trails that are almost impassable in wet weather. Many times a trail has to be cleared for moving camp.

Camp sanitation should not be overlooked. The camp grounds should be policed daily and all rubbish and garbage should be carried a safe distance from camp. The teamster should be required to keep his horses not nearer than 300 ft. from the camp, and if there is any slope he should select a site that will drain away from the camp. Human excreta becomes a nuisance and is dangerous to the health if a proper system is not followed. Trench latrines may be constructed but usually camp is moved too often to justify this amount of work. A simpler and safer method is to require each man, as soon as a new camp is established, to dig a hole about 3 ft. deep at least 300 ft. distant from the camp, and on the slope away from the camp. These holes can be dug in a few minutes with a 6-in. post-hole digger. Each time after these holes are used a few inches of the excavated earth is kicked into the hole. Water is usually obtained by sinking a well pipe, but this water must be boiled before being used for drinking purposes.

If you have hit upon a method

of doing your job quicker and easier than others, let them know of it through these columns. Once a month the "Job and Office" section of this journal will exchange valuable bread-and-butter information among its readers. What short and concise contribution can you give your brother engineer or contractor that may save him time, labor and expense?—*Editor.*

Subsistence—It is possible to furnish better food in camp than can be obtained in small hotels, and the cost will be from 50 to 75 per cent of the hotel rate. During the past 15 years on surveys aggregating more than 4,000,000 acres, I have observed that the party that had the best cook, the best food, and naturally the highest cost per man, turned out more work (other conditions being equal) than the parties that tried to cut down the cost of subsistence to the average contractors' camp cost. For long walks that field men are compelled to take the morale of the party must be good, and I believe that subsistence affects the morale more than any other one factor.

It is not desirable to have standard specifications as to food and rations, or to limit rations in kind and quantity. A good balanced diet should be aimed at, with the food prepared as near as possible to home cooking. It has been my experience that a good high-class cook who also has the ability to buy the food and manage the subsistence department of the survey is the best and cheapest in the long run.

Although the method of conducting the field survey depends to a great extent upon local conditions, the following general plan is suitable for the preliminary survey in many districts.

While the camp parties are being assembled a base or control line is run and closed around the boundary of the district by a transit and level party. The transit line is an azimuth and compass line with stadia distances, using a Philadelphia level rod with two targets. The transit party ties to all land lines and corners and also

notes the topography. The base level party follows the transit party. Each day's run is checked back upon itself and the circuit should close by checking within the allowable error $0.05\sqrt{M}$, where M is the length of the control line in miles. The levelman records high-water marks, ground-surface elevations, bank and bottom elevations, and the size of sloughs, bayous and other drains. He also sets bench marks at not more than half-mile intervals. These bench marks are usually on tree roots, the tree being blazed and scribed with the recorded number of the bench mark. Bench marks are also established on bridge piers and other permanent structures where possible.

For the interior survey, level lines are run across the district at intervals of from 660 ft. to one mile (depending upon the topography), and meanders with channel sections of all sloughs, bayous and other channels. The cross-level party takes high water elevations, surface readings at all changes in the ground slope, at instrument points and turning points, and also takes bank and bottom readings at all channels and sloughs. The larger channels are cross-sectioned and the top and bottom width of the minor channels are recorded. All ridges and swales are noted, with their general direction.

Survey Methods

Notes are taken as to the timber, vegetation and soil. Ties are made to land lines and corners wherever possible. Root bench marks are set at half-mile intervals and at channel crossings. These cross-level lines are run by compass bearings and stadia distance by the use of ordinary wye or dumpy levels equipped with stadia hairs and an attached 4-in. compass. The lines all begin at some point on the control line at one side of the district and are tied to the control line on the opposite side of the district. With ordinary care these cross levels check upon the base line within the allowable limit noted above.

The meander party meanders and takes cross-sections of all water courses and makes notes as to their condition regarding drift, growth and other obstructions. Data upon existing bridges are also obtained. Ties are made to the cross-level lines and to land lines and corners. Levels are carried in combination with the meanders unless the interval between cross-level lines is small. The topography between the cross-level lines may be sketched in by the use of a sketching case or some similar method.

Soil borings should be made at enough locations to give a general idea of the soil that may be expected during construction. When the improvements are located in the field, other soil borings are made on the line of improvement to give more detailed and definite information upon the material to be handled. The watershed, outside of the district, can usually be located and its characteristics determined by a reconnaissance survey supplemented by existing maps and data. Current meters should be included in the equipment in order that flow measurements may be obtained during storm periods.

It is necessary that all work be plotted and shown on the detail maps, to a convenient working scale, as soon as possible. If each instrument man uses two books alternately, it will be possible for the camp draftsman to map all the work, by the use of a drafting machine, the next day after it is taken in the field. In addition to the advantage in thus showing up any errors or omissions in the field notes it materially advances the design of the improvement, since the engineer can have earlier and more detailed information upon which to base his study. It has been found from experience that a map showing the elevations in figures is more convenient and more easily understood by landowners and contractors than if contour lines are used. In this respect it should be understood that the fall in the average eastern Arkansas drainage district is about 1 ft. per mile.

If the preliminary survey has been complete, as outlined above, the improvements can be projected upon the map with very small errors in location or in estimated quantities. Progress of surveys in timbered or cutover lands can be computed on the basis of 20 miles per month per instrument. The method of locating proposed improvements in the field does not materially differ from that used in the location of railroads and other improvements.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

Heavy-Duty Cableway Carriage Has Novel Features

IN conveying heavy equipment across the Kern River Canyon, in connection with recent power-house construction, the San Joaquin Light & Power Corp. had need of a cableway that could handle a 29-ton load. In order to get such a cableway in operation quickly and at low cost a carriage was designed and built on the job which fulfilled these requirements and is reported to have needed no repairs or maintenance.

CARRIAGE ABOUT TO PICK UP 29-TON LOAD.
(Note position of main sheaves giving bearing on deflected cable.)

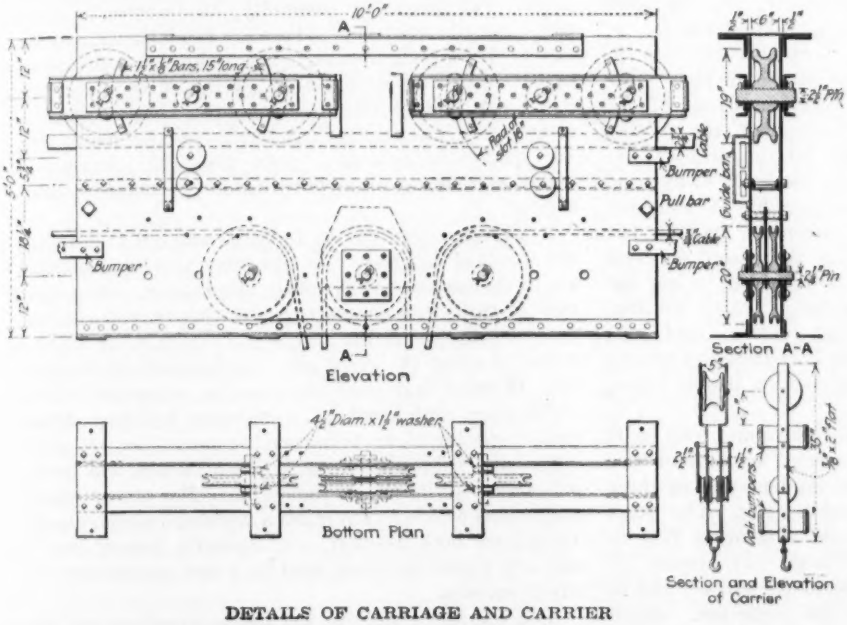
The general arrangement of the carriage is shown in the accompanying drawing. Simplicity and ruggedness were made primary requisites and use was made

FROM JOB AND OFFICE

For Contractor and Average Engineer

of materials available on the job. Features of its design were: (1) A box or framework with sides made up of heavy plates to give a rigid carriage; (2) an arrangement of main sheaves so each would take equal bearing on the cable under any load deflection of cable; (3) wide separation of sheaves carrying load line to prevent twisting of block and cable; and (4) self-adjusting bumper.

The arrangement of the main sheaves in pairs made it possible to connect rigidly each pair as a single unit which could be attached to the carriage by means of a shaft. Thus load transferred to the main cable through this shaft would be divided between the two sheaves for any position of the cable. Curved bars provided a bearing between the shaft of each sheave and the walls of the carriage to take any thrust due to the load pulling sheave units out of alignment.



DETAILS OF CARRIAGE AND CARRIER

Motor Truck Exhaust Cleans Pavement Cracks for Filling

JOINTS and cracks to be filled with bitumen on concrete roads in Warren County, Pennsylvania, were successfully cleaned with a hose attached to the exhaust of a small motor truck. About a 30-ft. length of ordinary ¾-in. rubber hose, provided with a ½-in. diameter gas pipe nozzle was attached to the exhaust pipe of the small motor truck used for hauling the tar kettle and other tools. The end of the gas pipe nozzle is drawn down to ¼-in. diameter. The crack or joint to be cleaned is first freed from any tightly packed dirt, by means of a metal "cleanout hook." The material thus loosened is then dislodged by directing the exhaust pressure of the motor, by means of the hose and nozzle, into the joint. The motor is speeded up to produce the necessary pressure at the nozzle. The method, it is stated, leaves a perfectly clean crevice. The exhaust gases, being warm, evaporate any moisture that may be present in the edges of the concrete, thus insuring a good bond between the concrete and the hot bituminous filler. The method is stated to be much quicker and more effective than the commonly used street broom, especially in getting rid of the fine dust, which if left in the crevices, may prevent the bitumen from adhering to the concrete. Burgess & Dorrier, Scottsville, Va., were the contractors.

How to Interest a Construction Foreman in Specifications

BY RAY S. BLINN
Locating Engineer, Mt. Vernon, Ohio

SUB-CONTRACTORS, grading contractors and many principals do not read word for word long specifications or even understand the lines and figures on an ordinary cross-section. Consequently, they get only a hazy idea as to the relative importance of certain things and, after the job is under way, they too often claim with great gusto and emphasis that certain things were not understood or the contractor was not told to do this or that. The result is that the engineer lays down the specifications and law before the poor man's eyes, and walks away. Friendly relations are severely strained.

There is a better way to handle such a case. Remember the man who is doing the objecting is a grading boss and not a philologist. The specifications are long and tedious and he just can't understand them.

When you hand such a contractor a bid blank and contract form, give him also a few high points—important things—on the first page, on the cover page if you like, possibly something like the following that will be noticed:

1. GRADE 18 FT. WIDE ON FILLS.
   GRADE 20 FT. WIDE ON SIDE HILL WORK
   GRADE 24 FT. WIDE ON CUTS
2. DITCHES 2 FT. DEEP, SLOPED
3. NO EXTRAS FOR ROCK
4. NO STUMPS ONE FOOT UNDER GRADE
5. BANK AND WIDEN CURVES
6. ENGINEER TO SEE AND PASS ON ALL SAND, ETC., ETC.

Of course these are merely high spots or pointers to be looked up in the specifications and drawings. But the method is a sure device to get men with limited literary training to read specifications and be interested in them.

Try it.

Practical Hints on Selection, Operation and Maintenance

Paving Mixers and Finishing Machines

CONCRETE paving is a machine operation and skillful selection, operation and maintenance of the machines are required to insure large production at low cost. This article contains instructions gathered from manufacturers and users of concrete paving machines and determined by field observations on many operations.—EDITOR.

CONCRETE pavement construction is virtually a field factory process. Paving mixers do more than mix concrete, they perform a succession of pavement fabricating operations. Where their work stops the finishing machine begins and by another succession of operations continues and completes fabrication.

In sequence the operation of a paver and finisher are: (1) *Charging*, which involves lifting the batch of proportioned materials and emptying it into the mixer, and, in some operations, also involves a preliminary operation of unloading batch containers from cars or trucks into the mixer charging skip; (2) *Mixing*, which involves automatic control of the speed of rotation, count of the number of revolutions, determination of the mixing period and measurement of the mixing water; (3) *Discharging*, which includes taking the batch away from the mixer and depositing it, spread roughly to thickness, anywhere within the zone of pavement width; (4) *Spreading*, which includes leveling the placed concrete to thickness; here hand labor is required to aid the mechanical strikeboard; (5) *Tamping*, which involves shaping the pavement to exact crown, and (6) *Finishing*, where again hand work is required to remove surface lumps, sticks and stones and to trowel edges, joints and rough spots.

Generally also the finishing machine cannot wait to do final belting, requiring either a special machine or else hand belting. Final belting must be done two or three hours after the first tamping and belting. The exact time depends on: (1) whether the cement is fast or slow-setting; (2) weather conditions, (3) amount of water in the mix which has to rise to the surface and be wiped off and (4) the ideas of the inspector. Again some highway engineers require a finer finish than is given by machine belting, or a special finish, like brooming, and these involve additional hand work. In some instances also, as with certain aggregates, machine belting does not give a satisfactory finish and hand finishing is necessary. Ordinarily the operations enumerated complete the pavement from raw materials at the mixer to the surfaced slab ready to be cured. They constitute, as previously stated, a field factory process. Emphasis is given to this fact because it is a factor in selecting, operating and maintaining paving mixers and finishing machines.

Selecting Paving Mixers

A mixer which will, as a machine, return the maximum profit is looked for by the contractor. The most profitable machine is the one the sum of whose operating, maintenance and overhead costs is the least. The machine factors which contribute to low operating cost are: (1) Endurance, which lessens the number of breakdowns; (2) speed and ease of operation, which give large output, and (3) mechanical simplicity, which makes repairs easy. Overhead is reduced by a machine having a large total output before being scrapped; a large capacity per day with a minimum number of operators and attendants, and a low first cost. The machine factors which keep maintenance costs low are: (1) Endurance; (2) mechanical simplicity and (3) good service on repair parts.

Putting like factors together, the machine requirements for profitable paving mixer service are, in the order of importance: (1) Endurance; (2) speed of operation; (3) mechanical simplicity, (4) operating simplicity, (5) service in repair parts and (6) first cost. These are fundamental requirements. With them always in the background, the details to be considered in selecting paving mixers are: (1) Size, (2) power, (3) traction, (4) discharging and distributing mechanism, (5) batch transfer mechanism, (6) quality of mix in a given time, (7) accuracy of water measuring, (8) fabrication, (9) manufacturer's service.

A paving mixer has to be large enough to maintain the specified progress. Its size must also be proportionate to the capacity of the other plant units. On isolated two- or three-mile contracts, with wheelbarrow charging from stockpiles on the subgrade, a 7-cu.ft. or 10-cu.ft. mixer is about the right size. Incidentally it should be kept in mind that stockpiling on the subgrade is being every year prohibited by more state highway departments specifications because: the materials get dirty; wheelbarrow proportioning is not accurate, and perfect subgrade conditions are impossible. For normal paving operations of five to ten miles a working season, practice recognizes both 14-cu.ft. and 21-cu.ft. mixers but the 28-cu.ft. mixer has been used by a few contractors with great success.

The volumes given are wet batch capacities and must be increased one-half to obtain the volume of dry materials measured separately. A 21-cu.ft. mixer, therefore, must be large enough to hold 32 cu.ft. of loose material, plus a sufficient quantity of water, plus enough surplus space to allow for out-of-level position while mixing. There must be no slopping even with a wet mixture. A 14-cu.ft. paver is correspondingly smaller but it requires about the same crew, has about 50 per cent less output and costs more per unit of capacity.

Assuming that a mixer is not bought for one particular operation and that concrete materials are delivered and charged mechanically, practice favors a 21-cu.ft. machine. A 21-cu.ft. paver will mix concrete as fast as ordinarily the contractor will be able to get the materials to it by truck, or industrial railway. A 28-cu.ft. paver is distinctly a large contract proposition.

Power for paving mixers has been steam as being more dependable and flexible and as being in the past better known to available machine operators. Recently gas engines have gained favor and the four-cylinder gas engine offers enough possible advantages over steam engines to be well worth consideration. It eliminates bad water troubles, the handling of heavy fuel, the extra

man for firing, injector troubles and time spent in getting up steam, cleaning boilers, etc. The four-cylinder gas engine, properly governed and of excess power, has eliminated practically all the troubles experienced with the old style single-cylinder engine, and the automobile has made more men capable of operating gas engines than can operate a steam engine.

Any motor for a paving mixer must be able to absorb load quickly as the load on the mixer changes rapidly. There is a variation from maximum to minimum power once for each batch or once every 1½ to 1¾ minutes and the change is instantaneous. Simplicity of design, full power, and flexibility are required of any paving mixer motor. In addition look for good balance; protection from dust and slopping concrete; mechanical lubrication; a low hung boiler, in case of steam power, to make firing easy and to keep the center of gravity low.

Mixer Types

Crawler traction is preferable for paving mixers. It does away with planking on soft subgrade and increases the manoeuvering ability of the mixer. Half-length crawler tractions, with truck wheels on the light end, and also full-length crawler tractions, have their advocates. The full-length crawler excels in mobility on the job. For swift movement from job to job, crawler traction is inferior to wheel traction. Ordinarily, however, the mixer had better be hauled or else carried on truck or car, from job to job, to save time and also to reduce wear and tear on the rather complex mechanism of crawler tractions.

With the tendency toward dry concrete firmly established, boom and bucket distribution is rapidly displacing chute distribution, because the dry mixture will not flow down a chute unless it is so short as to be impracticable. Also the boom and bucket gives a wider distribution from one position—up to 20 ft. in a half-circle about the discharge end. Except for lack of range and inability to handle dry concrete the chute has the advantage; it is cheaper in first cost, has greater output capacity, and has fewer operating parts. Two things require to be looked out for in boom and bucket distribution. One is that the boom can be swung when out of horizontal when working up or down hill and the other is that the bucket is full-batch capacity, or even larger, since the dry concrete piles up and requires more room than a wet mixture which spreads level.

With batch box carriage of proportioned materials either by trucks or by industrial railway cars, power is required to handle the boxes to the charging skip and then replace them. A mixer-mounted crane is the usual power appliance. The requirements for this crane depend on whether trucks or industrial cars carry the batch boxes. With trucks a longer boom and greater lift are necessary and a separate hoist is essential while in unloading from low industrial cars the weight of the descending mixer skip is enough power to operate the crane.

There are three principal requisites for a batch box crane: It should be adjustable to grades; it should be transferable from one side to the other of the mixer, and its weight should be supported independently of the mixer traction or truck wheels.

Observation of the details noted, with generally good fabrication and a reputation of the manufacturer for service, will guide the selection of a paving mixer. Reputation of the manufacturer for giving service counts more even than does past performance of the mixer. This fact is emphasized in the following section on mixer maintenance.

Paving mixers are usually delivered with the overhead frame dismantled and the charging skip and boom and bucket disconnected. There are some differences in the practice of different manufacturers. With an inclined runway built from the car floor to the ground the mixer should be moved off the car using its own traction. The runway should be at least 20 ft. long, the car wheels firmly blocked and the moving conducted slowly, with blocks ready to check any possible chance of a runaway.

With the mixer on the ground, the head frame is erected placing the marked members in order and bolting them loosely. When the whole frame has been assembled the bolts are tightened. A truck is advantageous for installing the charging skip and the bucket boom. They are often lifted and blocked up to be connected, but by loading them on a truck and backing the truck up to the mixer much hard work is eliminated.

All parts being in place, the installation of the sheaves and cables, adjusting them to tension, etc., calls for particular procedure which is specified in the detail erection instructions furnished by the manufacturer. Ordinarily the manufacturer provides a service man to direct erection and the final adjustment and tuning up of the whole mechanism. With a trained operator to receive the machine there will be no difficulties in particular but the machinery of a paving mixer is rather extensive and has to be closely correlated and no chances can be taken with jack-mechanics.

Wherever the service can be had and it nearly always can be, a large size paving mixer should invariably be erected and put in operation under the direction of the manufacturer's expert service men. This not only helps to insure perfect installation but it puts the responsibility for satisfactory installation on the mixer manufacturer.

Operating Paving Mixers

With certain general requirements common to good machine operation satisfied, efficiency in operating paving mixers is the result of skillful correlation of machine operations. Not including automatic operations, such as timing the period of mixing and counting the drum revolutions, there are fully ten machine operations in producing a batch of concrete dumped on the subgrade. As all these operations have to be accomplished in two minutes' time, or less, including one minute mixing time, their correlation so as to take advantage of every moment is plainly vital, if high efficiency is to be secured.

Important general requirements for good mixer operation are trained operators, convenient means for operation and care not to overload:

1. Trained paving mixer operators, whatever their wages reasonably may be, will save the contractor money by keeping the machine tuned up; by forestalling breakdowns by making repairs and replacements before failure occurs, and by pure skill in manipulating the mixer.
2. Convenience of operation requires that the control levers be arranged so that the operator need do little moving about and located where he can watch the operations he is directing.
3. Overloading is universally uneconomical in operating any construction equipment. In the case of paving mixers it not only strains the machine but it

retards the mixing action with positive danger to the quality of the construction.

In producing a batch of concrete dumped on the subgrade the following manually directed machine operations are required: (1) Unloading batchbox into charging skips, (2) raising the skip, (3) admitting the water, (4) shutting off the water, (5) lowering the skip, (6) opening the discharge spout, (7) closing the discharge spout, (8) manipulating boom and bucket and (9) moving the mixer along the work. Operations one and eight are in part independent of the others in time and of course moving the mixer, (operation nine) occurs only once about every 10 to 18 ft. depending on whether distribution is by chute or by boom. The frequency of moves depends on: (1) Size of mixer and batch, (2) width of road and (3) thickness of slab. Time co-ordination is required, then, chiefly in operations two to seven inclusive. Analysis by specific figures shows how close this time co-ordination is.

Time for Various Operations

The absolute time required for each of the essential mixer operations is: (1) Loading skip, 20 to 30 sec.; (2) mixing, 60 sec. (The specified mixing time in most states is 1 min. but Pennsylvania specifies 1¼ min., and North Carolina 1½ min. The Joint Committee on Concrete and Reinforced Concrete recommends 1¼ min. and it is quite likely that state highway departments will adopt this time more generally); (3) raising skip, 12 sec.; (4) discharging skip, 5 to 10 sec., depending on the shape of the skip, its angle of inclination and the wetness of the sand; (5) lowering skip, 5 sec.; (6) discharging mixer, 15 to 30 sec. depending on the mixer and the consistency of the batch; (7) distributing batch, 10 sec.

From this schedule the actual minimum possible time per batch equals time discharging skip plus mixing time specified plus discharging time plus about 10 sec. lost by even the most skillful operators. Using the figures assumed, this summation gives a batch time of 1¼ to 2¼ min. During this same period the skip is being lowered, loaded and raised for a coming batch, and the boom and bucket are distributing the previous batch.

Such close correlation of mixer operations, as has been indicated, requires high skill in operation and perfectly conditioned mechanism. These are both furnished by trained operators and can be had by no other means. A skilled operator by overlapping operations will add 10 to 20 per cent to the number of batches produced per hour by unskilled operation. The operator's skill shows in (1) having one batch start flowing out of the charging skip at the moment the discharging of the previous batch is completed (2) opening the discharge without loss of time after the specified time for mixing has elapsed and (3) closing the discharge as soon as the drum is empty and having the charging skip ready to start emptying into the drum at the same time.

Maintaining Paving Mixers

Maintenance has two purposes, one is to keep the machine, by repairs and replacements, always in condition for operation and the other to keep it tuned up to high efficiency. The more simple the machine and the fewer its moving parts, the easier both kinds of maintenance is, but the chief factor in keeping shutdowns few and repair costs low is the care and skill of the operator.

Two operating conditions which increase maintenance are overloading and dirty water. Overstrain in the machine, increases wear and failures. Clean water reduces boiler repairs and cleaning and the cutting of valves. With these conditions looked after, there are no maintenance requirements, barring accidents, which can not be met by making periodical inspections and keeping the machine clean.

Fifteen minutes a day after quitting time is enough to keep a mixer reasonably clean. In addition, an occasional half day, when the mixer is shut down, can be very profitably spent in a general cleaning. Unless a paving mixer is clean it is difficult to judge the conditions of the working parts; grease cups may be covered and go empty and bearings be cracked and worn without discovery until they fail. Also when a break occurs it may be necessary to spend valuable time removing concrete before repairs can be made. A half-batch of stone rotated a few minutes after the last concrete at noon or night has been mixed, will keep the drum scoured and a good brooming at night will clean the outside parts easily, particularly if they have been greased to prevent the dirt from sticking.

Periodical inspection to determine the condition of every part of the mixer and prompt replacements of worn parts are the requisites of good maintenance. A careful inspection should be made once a week besides the general examination given daily when the mixer is cleaned. With reasonable foresight in ordering replacements, delays can, by periodical inspections, be reduced way below what they are ordinarily.

Care of Equipment

Perhaps the most important maintenance factor in prolonging the life of a mixer, except periodical inspection, is its proper storage when shut down for the winter. The following procedure will meet the requirements:

Drain all water from the boiler and engine and also from the piping and water tanks. This should be done also when there is danger of freezing overnight. Pour about one gallon of cylinder oil into the boiler and a quart of oil into the tanks; fill again with water, then drain. It would be well to add a little white lead to the cylinder oil, just enough to give it a little body.

If the mixer is equipped with steam power, remove the hood from the boiler and clean the tubes out thoroughly with a wire brush and swab carefully with oiled waste or rags. Cover the top of the boiler with canvas and tie it down securely, then coat the inside of the fire box with heavy oil, and paint or oil the outside of the boiler.

Whether gasoline or steam engine is used, take off the cylinder heads and coat the inside of the cylinders with white lead and oil.

All hard working machinery, especially concrete machinery, must wear; therefore, examine the entire machine carefully and try out all the working parts and replace with new parts, those parts, if any, which are worn enough not to work properly.

By overhauling the mixer and replacing all worn parts when the mixer is shut down, no delay will be occasioned by having to make repairs when ready to restart the mixer in the spring. This should not be neglected for worn machinery decreases results, and increases delays and consequently labor.

After the machine has been thoroughly inspected and overhauled, coat all bright parts with heavy machine

oil, or, preferably, cylinder oil containing a good heavy body of white lead. Paint the rest of the mixer.

Grease all bearings carefully and turn the machinery over a few times to insure that the inside of the bearings are thoroughly coated. Take off the cables and clean them thoroughly with kerosene, then pass them through a bath of warm lubricant.

Clean the traction chain with kerosene and coat it with heavy oil. If possible house the mixer and in any circumstances cover it with tarpaulin.

Finishing Machine Practice

A finishing machine strikes off or spreads the concrete, tamps it and then gives the final finish by mechanically belting the surface. The essential considerations in selection and operation are:

(1) Does the particular type of machine meet with the approval of the engineer under whom the work will be done? Many state specifications say that finishing shall be done by an *approved* type of machine. The contractor should be sure that the particular one which he buys has the approval of the State Highway Department or of the engineer who has supervision of the work.

(2) The weight of a finishing machine is important; if it is too heavy, it may cause some deformation of the forms and produce an uneven surface. It must be remembered that the machine produces a surface in conformity with the top of the side forms, and any irregularity in these will show in the finished pavement; hence it is necessary that good forms be used and that they are properly set and braced. Wood forms are not recommended for machine finishing. The proper setting of wood forms to carry a machine satisfactorily means a greater cost in the long run than the purchase of the proper steel forms. In buying steel forms, however, it should be remembered that there are the heavy and the light forms the light forms being used only for hand finishing and the heavy forms being used for both machine and hand methods.

(3) For efficient operation, the finishing machine should be controlled from either side of the road; that is, duplicate controls should be provided so that the operator can run it from either side.

(4) Power for moving the machine along the forms both forward and backward should be supplied by all four wheels.

(5) The machine should be built so that if it is purchased for one width of road and later on the contractor secures a road of different width, the finisher can be changed to the new width at the minimum expense by securing only the cross members. In other words, the trucks, transmission, motive power, and operating mechanism should be standard for all widths of machine. In purchasing a finishing machine, it is of course necessary to specify the crown of the road for which the machine will be used. The strike off and tamper are cut to give this required crown on the finished pavement.

Adaptability of the machine for a special type of pavement such as striking off both courses of two course roads, and striking off and tamping concrete base for bituminous or brick pavements, is another feature which a contractor may well consider in buying a machine.

The capacity of the machine to finish concrete is in lineal feet rather than in square yards. The machine finishes the entire width of the road at one operation, and it requires practically the same amount of striking and tamping to finish one lineal foot of 10 ft. road as it does one foot of 20 ft. road, although the latter represents twice as much yardage. As a general rule, one finisher has ample capacity to take care of the largest paver. There are some conditions, however, which might make it necessary to use two machines, where the rate of progress in lineal feet per day is abnormally large, or where specifications require a greater amount of tamping than usual.

Street Railway Used for Freight Container Service

Innovation in Cincinnati Promises New Use for Trolley Lines, Better Freight Delivery and Lowered Highway Maintenance

REHABILITATION at slight cost of existing interurban street railways which have fallen into disuse through a variety of causes, in order to fit them for a new commercial service, and release from highways of a certain amount of destructive motor-vehicle traffic, thereby lessening highway maintenance, are highly possible if a system of moving package freight recently inaugurated in Cincinnati becomes widespread.

Through the establishment of a small off-track station in down-town Cincinnati, linked with the outlying rail transfer by the unit-container motor-truck system, the Cincinnati, Lawrenceburg & Aurora Electric Street R.R. Co., whose line extends from Cincinnati to Aurora

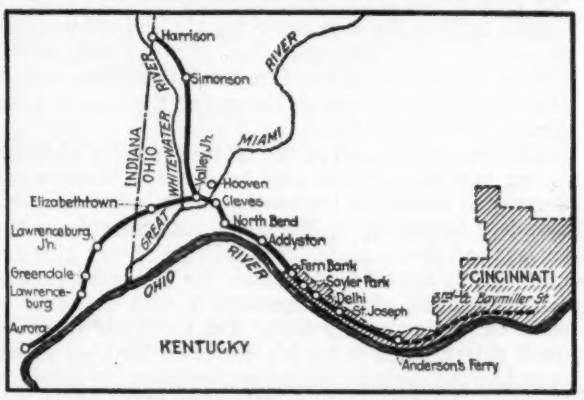


FIG. 1. MAP OF TERRITORY INCLUDED IN ELECTRIC RAILWAY PACKAGE-FREIGHT SERVICE

and Harrison, Ind., is handling package freight expeditiously through the use of demountable containers carried on flat cars. The motor-truck equipment and service are furnished by the Cincinnati Motor Terminals Co., which utilizes practically the same system as employed by that company in the interchange of less-than-carload freight between the twenty-eight main and sub-stations of the railroads entering Cincinnati. This system was described in *Engineering News-Record*, March 11, 1920, p. 508.

The essential features of the new package-freight service are the off-track freight station which is located at Third and Baymiller Sts. in the Cincinnati originating zone, a group of motor trucks with chassis designed especially to carry demountable containers, and a street railway car reconstructed to carry demountable containers.

The off-track station is equipped with a simple steel superstructure carrying an electric hoist for handling

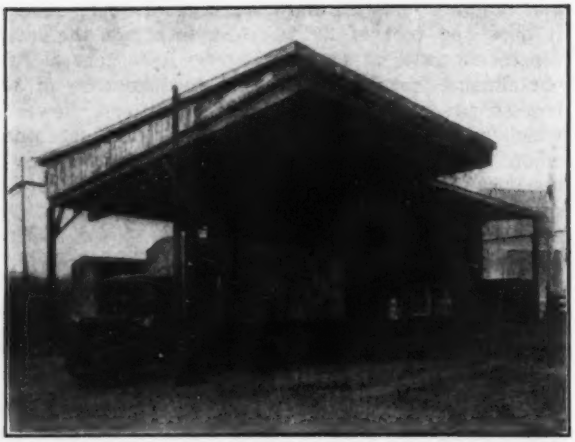


FIG. 2. MOTOR TRUCK WITH CONTAINER LEAVING OFF-TRACK STATION

demountable containers. Here freight is received from and delivered to shippers. It is conveyed between this station and Anderson's Ferry (see Fig. 1), the terminus of the street railway and the rail transfer, in containers carried by trucks. At the rail transfer the containers are mechanically interchanged between the motor truck and the flat car by an electric hoist, which is carried on the steel superstructure of the station.

From Anderson's Ferry sixteen stations on the electric railway are reached in a territory previously served largely by long-distance motor trucking, steam-line l.c.l. service and river transportation. By the new service freight is received at the Cincinnati downtown station at noon and is delivered at the end of the line 30 miles distant three hours later.

The freight received at the off-track station platform is run into the containers by hand trucks through end doors, and stowed in line-station order, allowing quick side-door unloading of individual consignments at the various rail destinations. The lading and way bills are made out at the off-track station for each consignment and an abstract of the shipments in each container is made out from the way bills. The terminals' company truck driver receipts for his container load, as represented by the abstract, taking two copies of the abstract, together with the corresponding way bills, to the rail transfer. There he retains one receipted copy of the abstract when his load is received by the container-train crew. All the freight carried in the containers by the terminals company is under the railroad's seal.

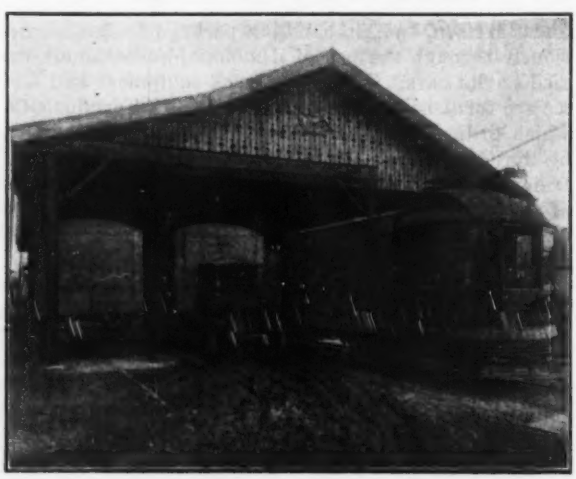


FIG. 3. INTERCHANGE BEING MADE AT RAIL TRANSFER

According to the schedule being followed at the present time two truck chassis arrive at the off-track station at 11:55 a.m., and leave with container loads five minutes later, one container loaded with freight for the main line and one with outgoing freight for the Harrison branch. At 12:40 p.m. the trucks arrive at the transfer where the demountable containers are exchanged for return-load containers, loaded with incoming freight, from the flat car. The distance between the off-track station and the rail transfer is 6.1 miles and the route lies through 1½ miles of city traffic.

Before the trucks arrive at the rail transfer the two-man crew of the container flat car has already mechanically unloaded the incoming containers from the flat car and placed them on wooden horses, awaiting the trucks. The use of horses increases the operating flexibility. Upon the trucks' arrival, the flat-car crew loads the outbound containers from the trucks to the flat car and

FIG. 4. SUPERSTRUCTURE WITH ELECTRIC HOISTS AT RAIL TRANSFER

trailer, and then loads the incoming container from the horses to the trucks. Five minutes is sufficient time in which to make each of these mechanical interchanges. The trucks with their return load are due at the off-track station at 1:30 p.m. The chassis are then released to the Cincinnati steam-line freight-interchange service and the containers are returned to the downtown station and set upon horses to be loaded for the next day's trip.

The flat-car container is operated by a motorman and a conductor, who handle the containers at the rail transfer and unload freight from the containers at the proper line destination. They also make store-door deliveries to and collections of light consignments from shippers adjacent to the rail stations.

At Valley Junction (see Fig. 1) the trailer is dropped off for a haul over the Harrison branch by a passenger car. The self-driven container car proceeds along the other branch to Aurora. Both termini are reached before 3 p.m. On the return trip freight consignments are loaded into the containers without regard to line-station order, since all consignments are segregated at the Cincinnati off-track station. If there is but one container for Aurora and one for Harrison the second

container on the motor flat car leaves Anderson's Ferry empty, but is used to receive volume commodities at local way points.

In addition to the regular business, retail dealers along the rail line use the service to secure emergency shipments from Cincinnati to cover shortages. The dealer telephones the nearest rail station from which the order is relayed by the railroad's private wire to the Cincinnati station. From there the agent transmits the call to the wholesaler and the consignment is delivered to the off-track station. It is possible for a shipment requested by a retailer at the end of the line before 11 a.m. to reach him by 3 p.m. the same day.

The amount of freight now being handled is considerable. By Jan. 10, 1922, a sustained daily average of 9,000 lb. outbound freight had been reached, in addition to a fluctuating inbound agricultural commodity movement of from 1,000 to 12,000 lb. daily. Thus it has been necessary occasionally to use an additional truck chassis. However, the service usually requires but two of the three containers provided.

At both the off-track and rail-transfer stations the superstructures, provided to carry the motor terminals' electric hoists, are of standard I-beam and channel sections with 10-in. channels serving both as beams and rails for the hoists. One departure from the construction at the off-track station is noted at the rail transfer. The channel trolley rails extend over the loading track. For this provision it was necessary only to raise the roof of the old passenger shed slightly.

The outside platform at the off-track station contains 382½ sq.ft. and the platform under cover 748½ sq.ft. exclusive of the small office at the rear. This floor area is extended to 1,028½ sq.ft. by the addition of the floor area contained in the two demountable bodies. An estimate is made that this fixed plant is capable of passing 160 tons of freight per 8-hr. shift.

Mobile Equipment

The mobile equipment consists of a five-ton truck chassis, six unit containers, a flat car and a trailer. The truck and containers are of the same standard as employed in Cincinnati for steam-line l.c.l. interchange service, except that the bodies are provided with sliding side doors. For this purpose angles are extended back from the side doors of the container at the top and bottom, the door is divided at the center, and a door-stop arrangement similar to that found in the ordinary box car is used. The containers are 17 ft. 6 in. long, 8 ft. wide, and 7 ft. 3½ in. high, inside dimensions.

The electrically-driven container flat-car has controls and trolleys at both ends. An old passenger car was remodeled for the purpose at a total cost of about $500. The body was removed, the car was cut in two, and extended about 3 ft. to provide the platform length for two containers. Steel angles, 3 x 3 in., are secured to the floor of the car laterally and longitudinally to hold the containers securely. The car is 59½ ft. long overall. The trailer is a simple steel frame 20 ft. long.

It is pointed out by B. F. Fitch, president of the Motor Terminals Co., and chairman of the board of the Cincinnati Motor Terminals Co., that the next logical extension of the service is the establishment of famers' off-track stations near stations along the rail line. Such platform stations would serve as receiving and assembly points for farm products and also as delivery points for unit-load consignments of shipments destined for rural delivery. Emphasis is placed upon the fact that the establishment of these platform stations would doubtless remove from highways a large percentage of long-distance heavy haulage, thereby lessening highway maintenance charges.

It is further pointed out that off-track station operation is possible in handling freight on any interurban railroad whether or not the rails reach the central traffic originating area of the city.

Rates charged shippers for the Cincinnati, Lawrenceburg & Aurora freight service average about 45c. per 100 lb., according to the distance and the commodity classification. Such rates are identical with steam-line rates for a service that has proved faster than express.

The motor-truck service, containers and hoists are leased to the Cincinnati, Lawrenceburg & Aurora R.R. by the Cincinnati Motor Terminals Co.

Dog Team Part of Tunnel Job Equipment

IN ORDER to carry on all-year-round construction on the 13.6-mile tunnel that is to bring additional water supply to Huntington Lake for power purposes, the Southern California Edison Co. operates camps on both sides of the mountain range through which the tunnel passes. The road to the adits on the far side of the range leads through a pass at elevation 9,300 ft. and is, of course, not passable during the winter

DOG TEAM IN SERVICE ON CALIFORNIA TUNNEL JOB

months. In fact it has not even been found desirable to attempt to maintain a telephone line and all communication is carried on by means of radio.

To afford means of winter transport in emergencies and to regularly carry the mail when the wagon road is impassable, the company brought a dog team and driver from Alaska which is now operating through the pass for the second season. The psychological effect on the considerable number of men in the remote camps has been found to fully justify the maintenance of the dog team. Seven dogs are ordinarily used and the regular schedule is a one-way trip daily over the ten miles between camps 60 and 61. In either direction this trip includes a climb of about 2,000 ft. to cross the high pass. When snow conditions are not unfavorable, the team can take a load of 500 or 600 lb. over this route. Although complete hospital equipment is maintained at the remote camp headquarters, a comfortable litter for the injured can be arranged on the sled.

The dog sledge is not used for carrying in ordinary camp supplies, these being taken in by trucks before the snow flies. As an example of the quantities required, when camp 61 was visited by a representative of this Journal in November, 112 dressed beeves were hanging in the meat house.

Plan to Bridge Hudson River at Anthony's Nose

Highway Crossing to Be Built by Company—Will Have 1,650-ft. Suspension Span—Tolls and Recapture Provisions

A 1,650-ft. suspension highway bridge across the Hudson River 40 miles above New York is projected by the Terry & Tench Co., contractors, and associates. A bill now in the state legislature proposes to charter a company under the name Bear Mountain & Hudson River Bridge Co., to build the bridge and operate it for thirty years as a toll structure, the bridge to become the property of the state at the end of that time.

Fig. 1 herewith indicates the relation of the proposed crossing 3 mi. above Peekskill, to New York City and the lower section of the Hudson lying between New York and Poughkeepsie, together with the main roads of this region. Opposite Peekskill lies the central part of the Interstate Palisades Park; Bear Mountain, rising from the west bank of the Hudson directly opposite Anthony's Nose on the east bank, is the main resort point of the park. The proposed crossing is at one of the narrowest points of the Highlands sections of the river, and is described by Mr. Sherwin as the most southerly location along the Hudson for a highway bridge of reasonable cost.

At the same site a railway bridge was projected fifty years ago, under the name of Hudson River Suspension Bridge & New England Railway Co., though the projectors of the present highway bridge scheme were not aware of this prior location and rights until they learned of it in the course of working out the details of their project. It is said that construction of the highway bridge will not render impossible the future construction of a railway crossing alongside under the originally acquired right-of-way easements.

FIG. 1. MAIN HIGHWAYS CONNECTING WITH PROPOSED PEEKSKILL BRIDGE

No highway bridge now crosses the Hudson in the 150 miles or more south of Albany, and the active passenger and vehicle traffic is handled altogether by ferries. These are badly crowded in summer, and in fact are greatly inadequate for the service required. While estimates of the probable traffic across the bridge have not been made in definite figures, it is believed certain that the bridge will easily pay for itself.

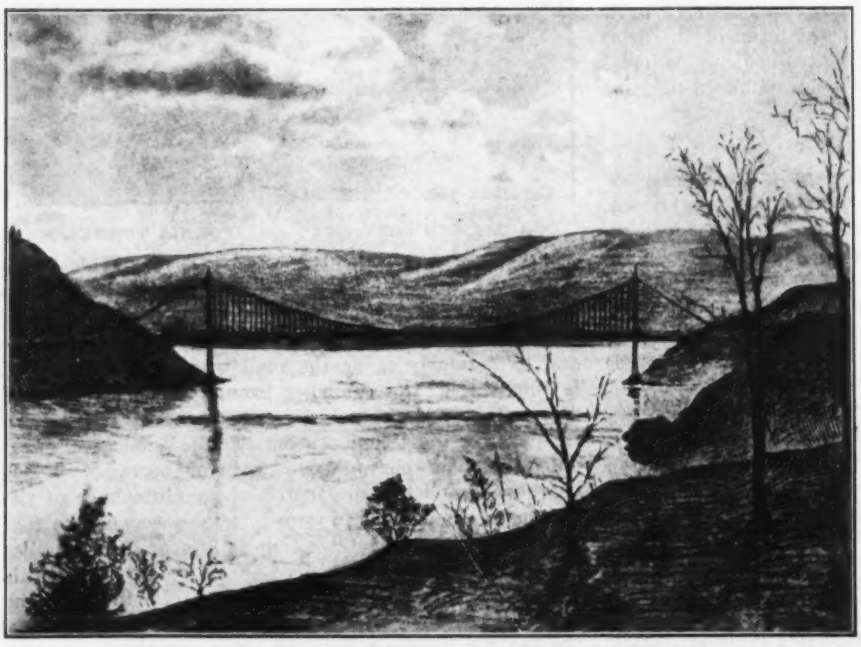


FIG. 2. SKETCH OF BRIDGE; LOOKING DOWNSTREAM
Anthony's Nose at Left, Bear Mountain at Right

Features of the Structure—Rock lies exposed at the shore line on either bank, and the hillsides rising directly from the water's edge provide direct anchorage. The span between towers located at the water's edge will be 1,650 ft. The clearance height will be 135 ft. The chartering bill fixes the minimum roadway width at 22 ft. with two 4-ft. sidewalks in addition, but the floor may be made considerably wider than this, as the long span requires a wide deck. Wire-cable construction is specified in the bill. The structure is to be proportioned for a loading of 70 lb. per sq.ft. on the roadway and 50 lb. per sq.ft. on the sidewalks and for a concentrated load of 30 tons. The design sketched in Fig. 2 is subject to modification.

Tolls and Recapture—Maximum toll rates are to be fixed in the charter at figures corresponding to present ferry charges. The figures range from 15c. for foot passengers to $1.75 for automobile trucks.

Thirty years after its completion the bridge is to become the property of the state. The state may acquire the property before this time by condemnation, or at five-year intermediate periods by paying stipulated sums ranging from $4,500,000 at the end of the first five years to $2,000,000 at twenty-five years from completion.

The total cost is estimated at $5,000,000. The project includes building a road about 2½ miles long running eastward from the east end of the bridge to connect with the Albany Post Road, which at this point is some distance back from the river, and a road 300 yd. long at the west end to reach the state highway running north and south along the west bank of the river.

Lesson of Chicago Grain Elevator Explosion; 1921

Dust to be Excluded and Not Merely Removed —Bins Covered—No Basement—Light Walls Used for Superstructure

By David J. Price and Hylton R. Brown
Engineer in Charge Development Work and Assistant in Grain Dust Explosions, Bureau of Chemistry, U. S. Department of Agriculture

THE dust explosion in the 10,000,000-bushel Northwestern grain elevator at Chicago, in March, 1921, was marked by such extreme violence as to give special interest to the investigation made subsequently by the Bureau of Chemistry, U. S. Department of Agriculture. The property and grain loss approximated $3,750,000, but only six lives were lost as the accident occurred on a Saturday night, when only the night force was at the plant. This elevator and the accident were described in *Engineering News-Record* of March 31 and April 14, 1921, pp. 560 and 634. The cause was noted in the issues of Nov. 3 and 24, pp. 719 and 847, in extracts from a paper by David J. Price ("Journal" of the Western Society of Engineers, December, 1921).

Swamp gas, presumably containing marsh gas or methane, was detected during the foundation construction, but there is no indication that this was a factor in the extent of the explosion. However, the U. S. Bureau of Mines has found that a small proportion of methane increases the inflammability of coal dust and this would be true probably of grain dust. In rebuilding the elevator, this gas was again noted, suggesting the desirability of definite control by ventilation.

Dust conditions at the Northwestern elevator are assumed to have been about the same as at the average terminal elevator. There was dust collecting equipment, but as commercial regulations prohibit the removal of dust before grain is weighed it is impossible to prevent dust accumulation in a large elevator.

Men were at work cleaning the driers and undoubtedly a large quantity of dust had been thrown into suspension. It is believed that the explosion was caused by fire in one of the driers, and the cleaning of the garners above the driers created the dust cloud through which the flame propagated to the basement of the working house, where the first heavy explosion occurred. There were at least two distinct explosions, the second and heavier one about ten seconds after the first. The first explosion must have been quite heavy, although small in comparison with the second blast which wrecked the greater part of the plant. An engineer living near the elevator reported that he heard a number of small explosions between the two heavier explosions.

From the results of previous explosions and considering the fact that this was probably the most violent dust explosion in this country, it was felt that the terrific shock had probably weakened the entire structure. However, the foundations and sections of the walls seem to have been undamaged and this will make possible the rapid repairing of the plant. For several years the Bureau of Chemistry has been recommending light wall construction for plants where it has been impossible to adopt sufficient precautions to effectively guard against explosions. At the time this elevator was being built the cement gun process of building walls on wire mesh or steel frames was coming into general use, and the use of 180,000 sq.ft. of exterior wall of this type was one of its construction features, as noted in *Engineering News-Record*, April 25, 1918, p. 819. One of the novel features of this work was the use of spring washers to attach the wire mesh to the steel frame work. This proved to be satisfactory, for when the walls were blown off many of the washers remained fastened to the steel beams. This explosion proved that light wall construction is advisable under certain conditions and prevents the building up of high pressures when an explosion occurs. The destruction of the light walls relieved the pressure and prevented serious injury to the structural steel framework.

An excellent opportunity was presented to observe the protection which covered bins afford. The storage section of the elevator and the river house where the bins were not covered were heavily damaged, but the working house, in which the bins were floored over, was damaged less than any other section of the elevator proper. In the storage section, where the bins were open and the flames could spread from one tank to another, at least fifteen of the concrete bins were completely destroyed. All storage bins should be covered and vented to the open air, with no direct communication between them.

The tremendous violence evidenced in the basement of the storage section of the elevator bears out the recommendation previously made by the Bureau of Chemistry that grain elevators should be constructed without a basement and with light walls or curtain doors to prevent the building up of excessive pressure underneath the bins in case an explosion occurs. The drier house and the track shed, practically a part of the working house, were a total loss. After the explosion scarcely a piece of structural steel which helped to form the framework of this part of the plant could be found in its original shape.

Vents should be provided on all elevator heads to permit the release of any pressure built up within the lofter legs, should an explosion occur. All ledges or surfaces where dust may accumulate in the building should be inclosed or beveled at such an angle that it will be impossible for large quantities of dust to accumulate on them. Electric lamps in dusty atmospheres should be protected with vapor proof globes and heavy guards. In large plants it is often advisable to use several small separate dust collecting units instead of one large system. The complete destruction of the large dust settling chamber installed between the working house and the storage section at the Northwestern elevator indicates that such installations should be at some distance from the main plant.

Good housekeeping is essential for the prevention of dust explosions and cleanliness is the most *important recommendation in guarding* against such disasters.

Letters on the Knickerbocker Theater Failure

Comments by Correspondents on Cause of Collapse and on Means of Assuring Safety of Engineering Structures—North End Joint of Main Truss Buckled

Responsibility and Pay

Sir—Your editorial in the issue of Feb. 2, p. 179, headed "Responsibility and Pay," is to the point. In this city the building inspector's office has no engineer connected with it, and consequently structural engineering designs receive only the most elementary checking.

I might add that I think 25 lb. per sq.ft. too light for roof loads, especially for buildings used for public assembly. I have had some experience with downspouts clogging up or freezing, and water backing up.

F. M. WEAKLEY,
Civil Engineer.

Norfolk, Va., Feb. 4.

* * *

Defective Wall Construction

Sir—It seems to me from the information given concerning the Knickerbocker Theater disaster that the failure is from the same cause that has produced a number of minor failures, or from a combination of this cause with another which has some major failures to its credit. In fact I know of very serious failures caused by each of these faults. The faults to which I refer are both faults in design; that is, they are due to conditions for which the designer is responsible. One fault is the use of hollow tile or blocks as the material of a bearing wall, particularly when the hollows are placed in a vertical position. The other fault is a composite bearing wall of a yielding and a rigid layer.

In *Engineering News*, Mar. 31, 1910, I referred to two chimney failures that seemed to be due to the use of perforated blocks, the hollow spaces being vertical. I called attention to the practical impossibility of securing any continuity of the compressed portions of the wall since it is not possible to make the ribs come over one another in a wall, and it is further impossible, in the ordinary way, to get any mortar between these narrow ribs if they were over one another. In *Architecture and Building*, July, 1912, in a series of articles on failures in building construction and their lessons, I referred to a number of failures of a minor character that were due to these causes. In one case a brick wall had a cast-stone veneer; the veneer cracked and spalled, showing that the wall load was being carried by the veneer. In another case a concrete column or pier had a cast-stone veneer. In another case a rubble stone wall had a cut-stone veneer. In another case a brick wall had a terra cotta veneer.

Some time ago I was called in on a case where a large section of reinforced-concrete work collapsed. The concrete beams and slabs were supported on walls that in part were built of two layers, a facing of hard brick with thin mortar joints and backing of common brick with thick joints. Some walls were a combination of brick and tile. I came to the conclusion, with good reason to substantiate me, that this particular failure was due to the yielding of the brick backing under the load and the consequent buckling of the wall and its collapse.

The walls of the Knickerbocker Theatre were composed of tile presumably faced with brick. The tile seems to have been laid with hollows vertical, judging by the photographs. The main truss supporting the roof rested on the tile portion of the wall on bearing beams and made a sharp or acute angle with the wall. A little yielding of his support would give the seat a slant that would account for the truss slipping off laterally, and the kick of the truss would account for the outward lean and for the crack in the corner of the building where the curved wall is broken away.

A large truss such as this without a pilaster or pier under it is bad construction. Supporting heavy loads on the inner tile shell of a well is also bad construction.

EDWARD GODFREY.

Pittsburgh, Feb. 7.

* * *

Curved Wall Displaced by Expansion

Sir—In your descriptions of the Knickerbocker Theater you show that one of the walls was built on a curve.

Some years ago the Lighthouse Department built a high brick wall around its property at St. George, Staten Island, and though it was built amply thick a great deal of trouble was experienced with that part of the wall that was built on a curve, on the street line. In spite of heavy anchors which were put in to hold it, the wall shoved out at the curve and leaned over the sidewalk to an alarming degree, so much so that it was really surprising that it did not topple out into the street.

This displacement of the masonry was explained by progressive expansion: as the wall expands with the rise in temperature, it shoves out at the curve, but the succeeding contraction does not pull the wall back into place, because the masonry has not sufficient tensile strength. The same action can be seen to a greater degree in heating furnaces in forge shops and steel mills. It occurs to me that such action may have shoved the theater wall out, and permitted the trusses to become unseated.

In any case where trusses are seated on masonry walls instead of being directly connected to steel columns, the trusses should be secured by means of rods running through the walls and fastened to clamps on the outside.

FRANK C. BOES,
Engineer.

East Aurora, N. Y., Feb. 8

* * *

Buckling of End Gusset of Main Truss

Sir—An independent investigation of the Knickerbocker Theater roof collapse, which the courtesy of Col. Charles Keller, Engineer Commissioner of the District of Columbia enabled the writer to carry out, has led to the discovery of some important findings of fact and deductions differing from those presented hitherto. They point to a decidedly unusual type of failure and give warning of a structural danger rarely thought of. Apart from this particular danger, the wreckage showed many inexcusable digressions from accepted engineering practice in the detailing and fabrication of trusses and column connections, to say nothing about radical departure from the truss dimensions indicated on final stress sheet and framing plans.

One vital fact has been determined and almost universally acknowledged by the engineers who have investigated this disaster: the separation of the north end of Truss T-11 from its bearing on the Columbia Road wall occurred very early in the sequence of events leading from the initial failure to the general collapse of the truss system and superposed construction. Professional opinions differed only in the development of intricate combinations of circumstances and hypothetical local failures at various points in the structure that might conceivably have brought about this separation.

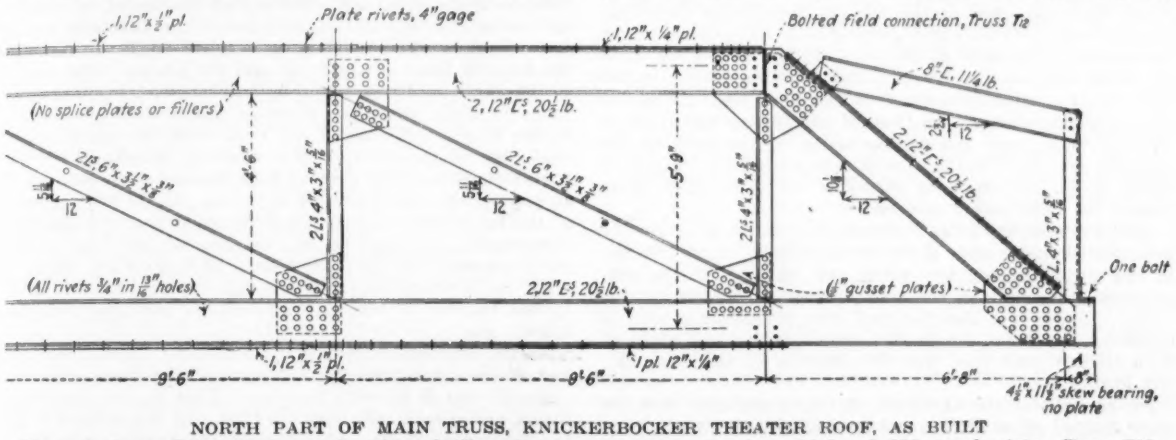
A trus concentration in excess of 100,000 lb. upon a 45° skew bearing was seated on the top flange of a single 20-in. I-beam with no intermediate bearing plate to protect the flanges of the relatively light 12-in. channels of the truss chord. Cover-plate joints were not spliced in either chord

of Truss T-11 but had at least ¼ in. clearance, and at both ends of the same truss the batter-post members, comprising two 12-in. channels back to back and a 12 x ¾-in. cover plate, depended wholly upon the strength and lateral stiffness of a single ½-in. gusset plate for their connection with its upper and lower chords. A preponderance of evidence indicates that the disaster was primarily caused by *the buckling of an an unsupported gusset plate* and the torsional failure, in its first panel length adjacent to the skew bearing on the Columbia Road wall, of the lower chord of Truss T-11.

Examination of the bearing beam revealed two deeply rust-marked pressure lines directly across its top in a diagonal direction corresponding with the original axis of Truss T-11 but measuring ⅝ in. apart at the front edge of bearing and exactly 1 in. apart where they become obscure just 6 in. further back on the beam. These pressure marks were caused by the concentration of load on the inside edges of the lower flanges of the two 12-in. channel sections making up the lower chord of truss T-11, and as ½-in. gusset plates were used throughout those lines should have been exactly ½ in. apart and paralled instead of widely divergent in both directions from the original truss axis. The evidence is conclusive that this marked distortion or spreading of the flanges of those lower-chord channels was not of recent origin but probably dated back to the initial loading of the truss system during the pouring of the concrete roof, if it was not the result of an accidental impact or slight tilting of the truss on its bearing to provide clearance for the connection of subsidiary trusses during their erection.

The immediate effect of that distortion was the concentration of the entire truss load on the edge of one lower chord channel and on less than 18 sq. in. of the other one, as the ½-in. gusset plate between them lacked an inch of even reaching the bearing beam. Normal deflection of the lower chord of truss T-11 under its computed static load resulted in an appreciable tilting of both of its channel members toward the east in the panel length adjacent to the skew bearing, and this tilting effect was further augmented on the night of the disaster by reason of the unusual snow load, causing slightly increased deflections in all trusses. Owing to the restraint imposed upon the upper chord of truss T-11 by reason of its partial embedment in the continuous concrete roof slab, practically all of the horizontal displacement resulting from exceptional deflection of the subsidiary trusses was transmitted to the lower chord and simply tended to increase the torque in its first panel length. The cumulative effect of all those forces and conditions, tending to turn the lower chord of truss T-11 over to the east or in a clockwise direction on its bearing, was resisted only by the gusset plate between the batter post and lower chord, as practically all of the bearing area remaining in contact under the truss was the relatively unsupported flange of the east channel, which readily bent the channel web as it folded up. The gusset plate in question was of adequate size to carry the entire truss load imposed upon it in direct axial compression, but owing to its location in the central plane or axis of the truss it had practically no lateral stiffness. As the adjacent channel sections in both upper and lower chords and batter posts were fabricated with at least ¼ in. clearance between them and probably more, there was apparently no provision made against the buckling or the bending of the gusset plate at either of these critical points in structure.

Hence, a load in excess of 100,000 lb. transmitted through the batter post at the north end of truss T-11 was balanced practically on a knife edge that was slowly turning over toward the east or in a clockwise direction on its skew bearing. Just as soon as an appreciable bending moment was created in the gusset plate, it reacted first as a column 5 in. in height and ½ in. in least diameter (computed as practically unsupported between centers of adjacent lines of rivets in the two members it connected), and then buckled to the east under the rapidly increasing bending moment produced by the truss load. These forces of over 100,000 lb., acting in opposite directions but not in the same straight line by reason of the increasing inclination of the lower chord members and the increasing bend in the gusset plate, soon produced an irresistible couple capable of developing a maximum bending moment in excess of one million inch-pounds, which literally twisted the steel channel sections making up the lower chord through an angle of approximately 100° in a clockwise direction, and rolled the main truss off of its skew bearing on the Columbia Road wall.



NORTH PART OF MAIN TRUSS, KNICKERBOCKER THEATER ROOF, AS BUILT

The main truss, T11, had six panels, with subsidiary trusses connected at the first, third and fifth panel-points. Truss T12, connecting at the first panel-point, was the northerly one of the three auxiliary trusses spanning from the main truss to the east wall of the auditorium, as indicated in the framing plan, p. 224, Feb. 9 issue.

The horizontal component of that tremendous reaction, as practically the entire roof structure started to fall, while probably indeterminate was certainly in excess of 40,000 lb. exerted as a direct thrust against the top of a curved wall 40 ft. in height and unsupported laterally in a length exceeding 150 ft. Of course, this irresistible thrust against the bearing beam was only exerted until the wall cracked and leaned outward the few inches necessary to release the badly twisted truss end, but it was sufficient, and in view of the secondary thrust which the same wall apparently received from the collapsing balcony it is remarkable that it survived the crash with so little cracking and displacement as we have observed and so freely criticized. This sudden displacement of the Columbia Road wall by the thrust of the main truss as it fell also explains the unseating of Beam 21, with consequent crushing of its tile bearing as it slid off, as an incidental result rather than the initial cause of the disaster.

The slight abrasion or milling of the edge of the flange of the bearing beam that supported Truss T-11 further indicates that the rolled-over flange of the twisted east lower-chord channel was the last surface in contact, and proves that the lower chord rolled or twisted in a clockwise direction from its seat on the bearing and retracted slightly to the southward as it did so. This hypothesis is also

confirmed and supported in detail by the present condition of the chord members themselves, by the direction and character of distortion in the gusset plates at both ends of the batter post, by the slight westward deflection at all upper-chord panel points of Truss T-11, by the condition of all subsidiary truss bearings on the 18th St. wall, and finally by the indicated direction of fall of the trusses and roof construction, scoring the east wall of the auditorium diagonally towards the rear as each subsidiary truss in falling released its corresponding bay length of purlins and roof-slab in progressive failure from the stage to the rear. Hence this analysis of the failure is confirmed in every detail by the material evidence and it is also in full accord with the testimony of witnesses.

Washington, D. C. ROBERT C. WALKER,
Feb. 8. Architectural Engineer.

* * *

Thrust Due To Truss Deflection a Possible Factor

Sir—In connection with the excellent article in the *News-Record* relative to the lamentable failure of the roof system of the Knickerbocker Theater, I drew the conclusion that the generally accepted explanation of the disaster, which finds currency at the present time, is to the effect that various vibrations and disturbances had caused a slow progressive movement of the end of the main truss upon its seat; that such movement was possible owing to the fact that the truss was not anchored to the wall; that the load upon the roof at the time of the failure had little or nothing to do with the determination of the time of the disaster, the fact that the roof was sustaining a load of about 12 lb. per sq.ft. in excess of its usual load being merely an unfortunate coincidence.

This explanation, extraordinary as it is, would seem the most plausible one were it not for two facts: (1) no defects in the plaster ceiling had given any warning of any progressive movement of the roof system in relation to the walls; (2) the fact that the roof was sustaining a load in excess of the usual, which fact should not be lost sight of even though such load was far inferior to the designing live load.

In the light of the first fact, it seems probable that the truss slipped off suddenly, and in the light of the second it seems not improbable that the loading had something to do with it.

One thing further should be taken into account, namely the fact that a truss under load deflects and that the deflection is greater the greater the load. In the present case the deflection under the slightly unusual load would probably have two effects, namely: (1) the end of the truss would "cock up," and the entire loading would be placed on the *edge* of the truss bearing, thus largely eliminating the friction between the bearing plate and the truss, and (2) the reaction of the truss would no longer be vertical, but would be inclined slightly toward the outside of the wall, thus putting the horizontal component of the reaction in the position of being a horizontal thrust at the top of the hollow-tile wall.

Is it not worthy of investigation to determine whether or not this horizontal component of the truss reaction (a force which exists in theory at the bearing of every unanchored and loaded beam or truss) was of sufficient magnitude to push out the hollow-tile wall and allow the truss to drop? In view of the fact that a wall constructed as was this one has practically no resistance to internal tension developed in bending, I believe it would be profitable to investigate this matter.

Of course, I am basing this discussion entirely upon the matter which has appeared in *Engineering News-Record*, and I have no dimension diagram which would enable me to determine the angle which the end of the bottom chord, and, consequently, the reaction, passed through from a condition of no load, to a condition of loading such as existed at the time of the collapse. However extraordinary it may seem that this small horizontal component of the truss reaction could produce the movement of the top of the wall which led to the disaster, it is no more extraordinary than the explanations which have been heretofore hazarded; it presupposes a sudden movement, and explains such movement; it explains the fact that the wall is now somewhat out of the perpendicular, leaning toward the street.

The lesson of the necessity for anchorage is plain, although in this case anchorage would have transformed a cantilever moment in the wall to another sort of bending moment of, probably, lesser significance; but it is vitally important to determine whether or not walls built of the material and in the manner of this one are so weak in bending that they should not be placed in positions of structural responsibility.

Des Moines, Feb. 14. PAUL E. WYLIE.

* * *

Effect of Skew Truss Bearing

Sir—The writer was formerly assistant engineer in the Engineer Department of the District of Columbia, and computed the lines on which was established the ground plan of the Knickerbocker Theater. The following considerations based on this work indicate the cause of the collapse, in the writer's opinion.

The main truss was supported at its northern extremity by an I-beam built into a hollow-tile wall. The axis of the truss formed a horizontal angle A with the axis of the I-beam. Deflection (or sag) in the truss due to the unusually heavy snow load would introduce a vertical angle B between the bearing faces of the truss and the I-beam. But owing to the angle A, stress would be transmitted (theoretically) from the truss to the beam-seat at the point of intersection of the lower west edge of the truss with the upper southeast edge of the I-beam. The angle B introduces a horizontal thrust equal to the load L of the roof times the sine of B, and parallel to the axis of the truss. At the bearing edge of the beam-seat this horizontal thrust is resolved into two components, one parallel to the axis of the I-beam, the other perpendicular to it, and equal to $L \sin B \cos A$ and $L \sin B \sin A$ respectively. The former component is balanced by the friction of the bearing parts of the truss and the I-beam only.

As the snow load increases the horizontal thrust increases, and at the same time the deflection in the truss and consequently sin B likewise increase. That is, the horizontal thrust increases faster than the load. At the moment when the horizontal thrust overbalances the friction, the truss slips along the edge of the beam-seat, thus increasing cos A, still further accelerating the process of collapse, while the base of the truss moves from its location and the truss tilts, thus introducing another horizontal thrust cumulative with the others. The slipping continues until the truss is clear of the beam-seat, when it drops to the ground.

Thus the support at the beam-seat of the main truss in the Knickerbocker Theater roof was in a condition of unstable equilibrium, in that each destructive factor increased with the process of collapse. Whether the failure could have been prevented by anchoring the truss to its seat, as suggested, depends upon the value of the angle A and the extent of permissible deflection of the truss. The difficulty of framing this structure occurred to the writer while engaged in computing the ground plan, and led to the above analysis, from which he concluded that in such cases the beam-seat should be built into a triangular pier, perpendicularly to the truss.

Examination of the northerly truss seat after the collapse of Jan. 28 shows distinct markings where the west edge of the face of the lower chord came into contact with the upper face of the I-beam. The southeast edge of the upper flange of the I-beam was considerably depressed to the northeast of these markings, and for a considerable distance was burred, and for the extent of several inches beveled. The tiling was torn away from the northeast end of the I-beam, while that southwest of the truss was undisturbed. This is what might be expected if the truss had slipped from its support in the manner described. The lintel remains solidly fixed in the wall, and the latter bulged 5 in. at this point, according to reports of the Engineer Department of the District.

Washington, Feb. 10. P. H. SKINNER, Consulting Statistician.

Discuss Concrete Products and Specifications at Convention

American Concrete Institute Meeting at Cleveland Mainly Concerned With Committee Reports —Few Papers Presented

DISCUSSION of current practice, as represented in committee reports, rather than final action on standards or presentation of papers, was the outstanding feature of the annual convention of the American Concrete Institute at Cleveland, Feb. 13-16. One committee presented a specification but a strong opposition minority report accompanied it and the convention referred the specification back for further study. Half-a-dozen papers were presented also, but most of the time was devoted to a discussion of concrete products and houses and to criticisms of the tentative specifications of the Joint Committee on Concrete and Reinforced Concrete. One morning session was given over to a practical demonstration, by Stanton Walker, of the methods used by the Structural Materials Laboratory of the Lewis Institute in designing concrete mixtures. This demonstration was most favorably received, particularly as most of the audience had never seen in practice the proportioning methods advocated by Prof. D. A. Abrams in his many papers on the subject.

In a partial reorganization of the Institute, started last year, it was decided that more attention should be paid to the concrete-products industry, which is experiencing a new lease of life after some years of quiet. Accordingly, three of the sessions were devoted to this subject, including one on concrete houses. In the latter session Miss Kate Gleason, well known as one of the few women engineers, gave a most interesting talk on the group of concrete houses which she has for some years been building at Rochester, N. Y. These houses, of the six-room and garage type, are built to sell for $4,000, and are distinguished by a grace of line uncommon in the quantity-production house. They are of beam-and-girder construction, slightly reinforced and of a sand concrete, using metal forms of Miss Gleason's designing. Several other papers described other types of small house, particularly a cement-gun type built near Boston and described by H. Whittemore Brown and concrete-block houses built in Youngstown, Ohio, described by B. E. Brooke.

Committee Reports

Committee S-5 on Reinforced-Concrete Houses submitted a proposed recommended practice for concrete-house construction, which was accepted as a progress report. J. A. Ferguson, of the committee, presented a lengthy revision of the recommendations as an individual contribution to the subject.

A radical division in Committee P-1 on Standard Concrete Building Units was revealed in the discussion of the report of that committee. New standards for block, brick and structural tile were presented by the committee, but a substantial minority were in opposition. The controversy was mainly about the requirements for concrete tile, which the minority contended would put that material out of the market. The committee was so nearly equally divided that the convention voted to refer the whole report back.

Other committee reports, with an abstract of their contents, are given below. None of the reports required any other action than acceptance by the convention.

S-6 on Concrete Roads.—Progress report. Committee will wait until the many current road tests are nearer completion.

S-2 on Highway Bridges.—Review of some current problems in bridge design, mainly waterproofing and expansion and construction joints. Abstract to be given in early issue of *Engineering News-Record*.

E-3 on Research.—Citation of research work now going on in United States and Canada. Programs of tests proposed on concrete mixers and theory of proportioning.

P-5 on Fire Resistance of Concrete Building Units.—Program of proposed fire tests on concrete block and tile walls. Convention voted to approve committee's recommendation that $6,000 be raised to carry on such tests.

C-1 on Contractors' Plant.—Addition to last year's analysis of comparative economies of different types of building construction plants.

C-4 on Metal Forms.—Analysis of some of the economic consideration in the use of metal forms.

The flexural strength of plain concrete was discussed in an elaborate paper by Prof. D. A. Abrams, who submitted results of a series of tests on that subject. He finds that flexural strength does not follow compressive strength uniformly. The modulus of rupture does not rise as rapidly as does compressive strength with the increase of cement content nor is it so seriously impaired by the increase of water, though the size and grading of aggregate, the curing conditions and the depth of the beam have about the same effect on both properties. The average modulus of rupture was found to be about 20 per cent of the compressive strength.

Prof. W. K. Hatt reported preliminary results on two series of tests now being conducted at Purdue University, one on the application of the ball test to concrete surfaces and the other on the fatigue of concrete. Each test has gone far enough to promise interesting results though nothing conclusive has yet been learned. They were reported, Professor Hatt said, because of the feeling that it is a good thing to make public the trend of new investigations even though they had not been brought to a conclusion.

A paper entitled "An Accurate Mechanical Solution of Statically Indeterminate Structures by Use of Paper Models and Special Gages" was given in remarkably clear abstract by Prof. George E. Beggs, of Princeton University. Prof. Beggs has developed a method of reproducing in paper and celluloid models indeterminate frames and by actual measurement of the deflection of critical members under applied loads has been able, with very simple calculations, to check the results of the complicated theoretical analyses of such frames by the slope-deflection method.

Joint Committee Discussion

One day was devoted to a discussion of the Joint Committee report. Nothing very different from the criticisms developed at the American Society of Civil Engineers discussion in December was brought forward. The main opposition to specification centered around Section 28, on Proportioning, and was mainly directed toward the second alternative of that section which requires that the contractor be responsible for the strength of the concrete. As a part of the criticism an attack was directed on the cylinder test as a measure of structural strength. Members of the Joint Committee repeatedly asked the critics for a substitute proportioning clause but none was given. Those opposed to the strength specification seemed willing to allow proportioning to continue on its present volumetric

basis. A good many criticisms of detail provisions were advanced, but they apparently were largely a matter of interpretation, indicating the necessity of revision to insure clearness in the specification.

COST OF BUILDINGS ANALYZED

A. R. Lord, a member of the Joint Committee, presented an analysis of the cost of concrete buildings as designed under the building codes of different cities and under the Joint Committee tentative standard. This showed that for the concrete work in flat-slab buildings the tentative specification would cost 8 per cent more than the average of six cities and for beam-and-girder buildings 10 per cent less, assuming a 2,000-lb. concrete in all cases. This would mean for the whole building 1.6 per cent more and 2 per cent less, respectively. The opposition, however, contended that the requirements for strength, in other words the proportioning specification, under the Joint Committee's ruling, would materially increase any purely structural analysis. A committee of New York contractors presented a comparative analysis of a building under the New York code and the Joint Committee specification which showed increases higher than the averages of the six cities but apparently not much higher than those given by Mr. Lord for New York. The committee, however, contended that the specification is decidedly punitive in its effect on concrete.

The Wason Medal for the most meritorious paper presented to the previous convention was presented to Prof. H. M. Westergaard, of the University of Illinois, for his part of the paper on "Moments and Stresses in Slabs" entitled "Analysis of Homogeneous Elastic Plates."

The American Concrete Institute is growing rapidly. It was reported that the membership at the end of the convention had reached 873 and that the finances were satisfactory. William P. Anderson, of the Ferro-Concrete Construction Co., of Cincinnati, was elected president. Harvey Whipple, Friesma Building, Detroit, Mich., is secretary.

Experimental Study of Continuous Arches Proposed

Study of concrete multiple arches by full-size tests has been proposed to the Engineering Foundation by A. C. Janni. The object of the study is to confirm or correct the theory of stresses in such elastically continuous arch spans. It is understood that the collapse of three spans of the Palm Beach bridge stimulated the proposal. It is known that an arch in a continuous series, supported by relatively slender piers, cannot be considered as having unyielding supports as promised in the ordinary analysis of an arch. Both the yield of the pier and the elastic reaction of the adjoining arch affect the stresses in the arch in question. Current methods of designing do not take account of this effect, and while a rather complex method of stress calculation exists there has been no experimental verification of its correctness. A test on three or four spans of arch, of say 70 or 75-ft. span, might be expected to furnish such verification. Fixed end abutments and slender intermediate piers would be provided, and deflection and strain measurements would be made under various loads. The Engineering Foundation has referred the subject to its advisory committee on civil engineering research, and has suggested that if the proposed test is considered desirable the co-operation of the American Society of Civil Engineers will probably be asked for.

The British Water Supply Shortage and Emergency Treatment Measures

(London Correspondence)

BRITISH authorities have now become thoroughly alarmed at the shortage of water throughout the country and are taking steps to insure that all supplies are conserved. The seriousness of the position is revealed in the decision of experts to recommend to the Minister of Health that: (1) Water must be utilized which in normal circumstances might not be regarded as suitable for consumption. (2) Existing sources of supply might become polluted owing to the drought, and measures will have to be taken to destroy the impurity. Such measures might demand the action of Parliament.

The survey made last year of the available supplies of the country show that 126 important districts have a pronounced shortage, and that in 52 of these districts the supply has fallen 50 per cent below the average.

January of this year is the first month since January, 1921, when Britain has had her normal rainfall, so that the position at the end of last year, when there was an all-round deficiency in rainfall of about 40 per cent, is in no way relieved. In fact, in many important districts—as Bristol and Bath—water rationing has been resorted to, and in many villages water is being retailed at so much per pail.

Several rivers have dried up altogether, and the Kennet, from which large supplies are normally drawn, is bone dry for several miles. In addition many of the deep-seated chalk springs throughout the country have completely dried up. Thus, even if February should prove an abnormally wet month many of the chalk springs and smaller rivers will not be available for water until July, provided subsequent months are normally wet.

In many districts, where the water has been derived from hills, the rivers will be resorted to and chlorination, so effectively applied in foreign theaters during the late war, will be employed.

In the meantime the Littleton reservoir, under construction for some time, is being pushed forward. This reservoir is to hold 6½ billion gallons (Imp., or 8 billion U. S.) will cover 800 acres and will keep London going for a month. Water for this reservoir will be drawn from the Thames by centrifugal pumps lifting 300 m.g.d., (Imp.) per day. A thousand men are now employed on it but it is doubtful whether it will be available for use inside two-and-a-half years.

According to the London *Engineer*, the Ministry of Health recently created a technical committee of nine members to advise it on the best method of treating water, possibly from polluted sources. On the committee are four representatives of the Ministry of Health, including L. G. Gibbon, assistant secretary, who serves as chairman; E. A. Standford Fawcett, chief engineer; a medical man, and one other. Other members are Sir Alexander Houston, director of water examinations to the Metropolitan Water Board; T. W. Davis, a waterworks engineer, representing the British Waterworks Association; Raymond Ross, public analyst for Burnley, and two local medical officers of health.

An article on the British drought appeared in *Engineering News-Record*, Nov. 17, 1921, p. 820.—EDITOR.

NEWS OF THE WEEK

New York, February 23, 1922

Federal-Aid Road Bill Delayed Pending Soldier-Bonus Policy

(*Washington Correspondence*)

Due to the uncertainties aroused by the soldier bonus situation, it has been decided not to start hearings on the federal-aid road bill until something more definite is known as to the sources to be relied upon for that revenue. It seems certain that the proposal to raise a part of the money needed for a bonus from a gasoline and automobile tax is dead. Some very influential members of Congress, however, attach such importance to the need for bonus legislation that they are willing to suspend all road work and certain other public improvements so as to provide the necessary funds with the smallest possible increase in taxes. It is becoming increasingly apparent that increased road appropriations for a period of years or even for the next fiscal year will not be forthcoming without a legislative fight.

Kenyon Business-Cycle Bill Returned to Committee

(*Washington Correspondence*)

Such determined opposition met Senator Kenyon's business-cycle bill, when it was called up for consideration on the floor of the Senate, that the bill was sent back to the committee on Senator Kenyon's own motion. He took that action when the Senate by a vote of 29 to 26 adopted an amendment restricting the application of the measure to public buildings.

That Congress is very jealous of its perogative to indicate when and where expenditures of public funds are to be made was demonstrated again by the action taken on this bill. To vest even limited control over these funds in the executive met with little favor.

Senator Kenyon championed the bill vigorously. He said it would be no panacea, but that it certainly would tend to counteract the extreme swings of the business cycle if public works could be stimulated during times of industrial depression and held back during times of great industrial activity.

Despite the admitted strength of Senator Kenyon's arguments, little sympathy for the proposal was aroused, and it is admitted that a different type of proposition must be evolved before there is any hope of securing legislation of this character.

In connection with the failure of the bill, Commerce Secretary Hoover stated that he feels the subject should have more illumination before legislation is attempted.

Demand Higher Motor Fees

The Board of Supervisors of San Bernardino Co., Cal., last month passed a resolution protesting against the further issuance of licenses or franchises to trucking and stage lines until fees charged or taxes paid "are sufficiently high and do bear a just proportion to the expenses in maintaining our highways."

Booth & Flinn Bid $19,331,723 on Hudson Vehicle Tunnel

Booth & Flinn, Ltd., 17 Battery Place, New York City, with an offer of $19,331,723, were the low bidders Feb. 15 on the contract for the construction of the Hudson River vehicular tunnel, involving twin tubes of cast-iron, 29½ ft. in diameter, to be constructed by the shield method. Two other contractors submitted figures as follows: Patrick McGovern, $20,917,267; Keystone State Engineering Co. and Holbrook, Cabot & Rollins (a joint bid) $22,191,635. (For unit prices see construction news section of next week's issue.)

The work is under the joint administration of the New York Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission for which Clifford M. Holland is chief engineer.

New Jersey's $40,000,000 Road Bond Issue Passes House

The $40,000,000 bond issue for the completion of the New Jersey state highway system has been adopted by the House of Assembly by a vote of 41 to 15. Assemblyman Pierson sponsors the bill for a referendum on the bond issue at the November election. The plan proposes the expenditure of $8,000,000 annually for five years. The measure continues the 1-mill direct state tax.

Federation Membership Opposed by New York Section, Am. Soc. C. E.

With an attendance of about 135 at its meeting in the Engineering Societies Building Feb. 15, the New York Section of the American Society of Civil Engineers, by practically a unanimous vote, disapproved the proposal that the parent society should become a member of the Federated American Engineering Societies. The vote was taken at the request of the Board of Direction in an effort to discover the sentiment of the various local sections on the federation question.

The decision of the New York Section was expressed in the passage of a resolution offered by G. L. Lucas, which pointed out that the proposal to join the federation had been defeated by letter ballot Nov. 8, 1920; that the receipts of the parent society are not now adequate for the support of the local section; that the expense of joining the federation means $10,000 for the first year; and that the internal welfare of the society should receive first consideration. The payment of dues to the federation, the resolution stated, could only be done at the expense of the welfare of the society's local sections.

Equalize Transit Facilities, Says D. L. Turner

Consulting Engineer to Transit Commission Outlines Plan for N. Y. District

Extension of rapid transit facilities into new territory, instead of more intensive development of existing congested areas, was the solution to New York's transit problem offered by Daniel L. Turner, consulting engineer to the New York Transit Commission, at the Feb. 15 meeting of the New York Section, American Society of Civil Engineers. Present transit facilities, Mr. Turner stated, do not provide an equality of service for all residents of the city and this end can never be achieved as long as transit facilities trail behind traffic requirements. Rapid transit, it was emphasized, should precede, not follow, population. The routing of lines should be based on the area of the city served and not on the traffic immediately in sight.

Private ownership and operation, Mr. Turner believes, produce an unbalanced and undesirable development. He prefers municipal ownership with a monopoly of operation by a single private company under public control. In developing a plan of municipal ownership and private operation, according to Mr. Turner, several operators of the transit lines may be necessary at first, but ultimately a single company should exercise all of the operating functions.

In spite of the fact that New York City has been building subways since 1900, the work has gone along intermittently and is now ten years behind actual transit requirements.

Discussion

The discussion was opened by Edward A. Roberts of the staff of John A. Beeler, consulting engineer, who confined his remarks to the operation and equipment of surface lines. The two chief problems of the street railways at present, he said, are to reduce operating expenses and at the same time give better service. These ends are being met in some cities by the use of a new type of light safety car, operated by one man and moving at higher speeds than New York City's present types of street car. Increase in headway, Mr. Roberts pointed out, is a great factor in operating economy. Tests in a Middle-Western city showed that with an 8-min. headway the daily earnings were $21 per car, which increased progressively until with a 2½-min. headway earnings of $40 per car per day were recorded. Irregularity of street-car service was cited as one of the chief causes of public distrust of this type of transportation. Time can be saved, Mr. Roberts said, and revenue increased by the use of loading platforms and the adoption of the skip-stop. If the average speed of street cars on Manhattan Island could be increased by 1 mile per hour, there would be available an additional 13,000,000 car-miles per year.

Utilization of New York City's existing rapid-transit trackage to the limit by the employment of proper equipment and operating methods was a remedy which Frank J. Sprague recommended as a means of immediate relief. The subway's maximum operating capacity can best be realized, he suggested, by having a motor drive on each axle of each car and a brake on every wheel. Under present operating conditions trains must run on a greater headway than would be the case if the car units composing the trains were so equipped as to make possible the maximum acceleration and deceleration.

Exception was taken by Mr. Sprague to Mr. Turner's advocacy of the universal transfer principle; he pointed out that this practice causes congestion by people who, to avoid only a short walk, will invariably secure a transfer, thus increasing the number of passengers to be handled.

As seen by Henry M. Brinckerhoff, the transit problem in New York is essentially one of the delivery end of the line rather than the home or starting point of the route dealt with at length by Mr. Turner. The danger in providing additional transit facilities, he said, lies in the bringing of all lines into the heart of Manhattan Island.

Dayton $3,000,000 Public Works Bond Issue Illegal

The $3,000,000 bond issue voted for various municipal improvements in the city of Dayton (Ohio) in April, 1920, the legality of which has been questioned since that time, was declared illegal by the Supreme Court of the State of Ohio Feb. 14. The issue received a majority vote, but a state law requires a two-thirds majority, which was not attained. The city commissioners contended that a provision of the city charter permitted an issue of bonds if a bare majority was received. The proceeds of the issue were to have been used as follows: Street and sewer improvements, $1,738,500; storm sewers, $643,000; parks and playgrounds, $283,000; bridges and culverts, $202,000; fire equipment, $263,700.

Would Pool Railway Rolling Stock and Terminal Facilities

A plan to pool the 2,500,000 freight cars of the country with one central agency under railway auspices has been proposed to the Interstate Commerce Commission by S. Davies Warfield, president of the National Association of Owners of Railroad Securities. The purpose of this plan is to coordinate the control, inspection, repair and rebuilding of all interchange freight cars in order to meet more effectively the regional and seasonal freight car requirements of the country. It is suggested that the National Railway Service Corporation, organized by the association of security owners, might perform this function in collaboration with the American Railway Association for the railroads and the Interstate Commerce Commission.

To avoid costly duplication of capital investment, the security owners' association advocates also a more general joint use of terminal facilities and announces that under its auspices a committee of engineers is now studying this problem.

N. J. Sewage-Works Operators Hold Experience Meeting

The annual meeting of the New Jersey Sewage Works Association, held at Trenton on Feb. 17, was largely devoted, as were the six preceding ones, to an exchange of experiences on the part of sewage-works operators and of engineers in private practice and connected with the State Department of Health. In a neighborly way, engineers engaged on City of Philadelphia sewage-works design are included in these meetings. The association now has 79 members.

In the course of a paper describing the Pennypack (Philadelphia) sewage-works and their operation for ten years, Harry Beaumont stated that the hypochlorite disinfection of the Imhoff-tank-sprinkling filter effluent had been successfully used throughout, except during 1916, when the war made it necessary to substitute liquid chlorine. The latter was less satisfactory than the hypochlorite.

Prof. R. O. Smith, of the New Jersey State Experiment Station, New Brunswick, N. J., outlined the research studies being made jointly by the Station and the State Department of Health, with the co-operation of the Research Committee of the Sewage Works Association, headed by John R. Downes, of the Plainfield joint sewage-works. These studies have included some phases of the biology of sewage treatment and experiments with sulphuric acid and with sulphate of alumina to facilitate sludge dewatering.

S. F. Miller, of the Pacific Flush Tank Co., was elected president and Myron E. Fuller, assistant engineer, Fuller & McClintock, New York City, was re-elected secretary-treasurer.

Ulen & Co. Formed to Construct South American Projects

To co-ordinate the activities of three groups of American engineering interests which have been working together in South America as voluntary partners, the firm of Ulen & Co. has been incorporated under the laws of the State of Delaware with an authorized capital stock of $5,000,000 preferred and 100,000 shares of common stock of no par value. The American International Corp., the Ulen Contracting Corp., and Stone & Webster, Inc., are subscribers to the stock to be issued immediately.

The company was formed to finance and carry out all construction contracts now under negotitation and all prospective business which has been developed in Latin-American countries during the last five years by the Ulen Contracting Corp. This corporation has already completed various engineering works in South America, including water and sewerage projects in cities in Uruguay and Bolivia, and is now engaged in constructing 128 miles of railroad in Bolivia, for which Fred Lavis is acting as engineer, and J. B. Cameron in charge of construction.

The directors of the company are Matthew C. Brush, Gordon H. Balch, Harry A. Arthur, Howard L. Rogers, M. J. Whitson, Frederick P. Royce, Henry C. Ulen, Thomas S. Sheppard and C. M. Bounell.

The officers are: President, Henry C. Ulen; vice-presidents, C. M. Bounell and Thomas S. Sheppard; treasurer, T. F. Devaney; secretary, Earl C. Ulen.

Designers and Builders Blamed for Knickerbocker Collapse

Following the brief summary of the coroner's jury findings on the Knickerbocker Theater roof collapse of Jan. 28, reported p. 294 of last week's issue, the full text of the findings is quoted below. The jury primarily blames the architect, the engineer, and the general contractor and steel and masonry subcontractors, although the administration of the building department, its current methods of work, and the building code of the District of Columbia are also held to be faulty. The verdict was returned on Feb. 14. It reads:

"Mary E. Atkinson came to her death Saturday, January 28, 1922, from fracture of the skull, hemorrhage and shock caused by the collapse of the roof of the Knickerbocker theater, Eighteenth street and Columbia road, Washington, D. C., due to faulty designing and construction and inadequate supervision and inspection, and we hold Reginald W. Geare, John Howard Ford, Morris Hacker, Donald Wallace, Frank L. Wagner, Richard G. Fletcher, John L. McDonald, Thomas L. Costigan and Julien R. Downman for the action of the grand jury.

INSPECTOR QUALIFICATIONS LOW

"It is noted that no special qualifications are essential in filling the position in the office of building inspector; that the testimony of witnesses from the office of building inspector, with one exception, shows a lack of knowledge of conditions and proper supervision of buildings erected in the District of Columbia; that the reports made by field inspectors were unintelligent and that little or no attention was paid to them, they apparently being made only as a matter of form and not with any idea of following up or checking any defects, showing the lamentable lack of appreciation of responsibility.

"It is also noted that many of the witnesses testifying in this case have done so with much evident unwillingness and mental reservation.

"We recommend a through revision of the building code in the District of Columbia, with a heavy penalty for violation of any of its clauses.

"We also recommend that all theaters and places where the public assembles be closed and kept closed until such time as their safety is assured.

"We further recommend that the city fire department be equipped with oxyacetylene torches and tanks, jacks, searchlights and such other equipment as would be needed by a wrecking crew in an emergency, the lack of which equipment seriously handicapped the rescue of the victims of the Knickerbocker disaster."

Would Study St. Lawrence Project Before Congress Takes Action

The Merchants' Association of Greater New York has filed with the House Committee on Interstate and Foreign Commerce a request for delayed action upon the St. Lawrence ship-canal project until the report of the International Joint Commission can be studied and analyzed. The memorandum, signed by James Gilbert White as acting president of the Merchants' Association, has been sent to every member of Congress, to President Harding and other officials.

Fourth Offer Made for Taking Over Muscle Shoals Plant

The Alabama Power Co. of Birmingham, Ala., represented by Thomas W. Martin, president, has submitted the third rival to the Henry Ford offer for the completion and operation of the Muscle Shoals water-power and nitrate manufacture project begun by the federal government during the war. In contrast with the Ford requirement of a large government expenditure and a 100-year lease, the Alabama Power Co. would require no government outlay (except a small allowance noted further on) and would accept a 50-year license, with federal recapture clause at the end of that time, all as provided in the federal water-power act.

The company offers: (1) To complete the dam, locks and power house known as Wilson Dam or Dam No. 1, with an initial installation of about 240,000 hp., with provision for future extensions; (2) to furnish free to the Government or its designated agent 100,000 hp. for the manufacture of fertilizers and war munitions and for related research, and to buy this amount of power from the Government in case of discontinuance of its use for the purposes stated because of "changes in the act," this horsepower to be the second 100,000 hp. "available from the normal flow of the river"; (3) to buy the Government's interest in the steam plants of the company's Warrior extension and of Nitrate No. 2, and in certain transmission lines and housing facilities, the company to pay the Government $5,000,000, less an amount to be agreed on to cover the cost of locks and navigation structures at Wilson dam; (4) the company offers to operate and maintain the power plant, dam and gates, the Government "to operate and maintain the locks," but the company to supply the necessary power without cost to the Government; (5) the Wilson Dam property and construction plant to be transferred to the company and the locks and navigation structures to be conveyed to the Government on completion; (6) the Government to have the right to take over and operate the plant in case of war necessities, as provided under the act.

H. L. Cooper Opposes Ford Proposal for Muscle Shoals

Strong opposition to the acceptance by the federal government of Henry Ford's offer to purchase and lease the Muscle Shoals properties in Alabama was made at a hearing before the House Military Affairs Committee Feb. 17 by Hugh L. Cooper, consulting engineer to the government on the Muscle Shoals development. Col. Cooper said that to remove the super-water-power project of the South from use by public utilities for 100 years would be a calamity. He declared that the maximum length of lease of government lands carrying water-power rights should be 50 years, and only that long when the license is subject to the regulations of the water power act.

Col. Cooper also maintained that, based on U. S. Army Engineer data, acceptance of the Ford proposal would cost the government $1,275,000,000 "in order that Mr. Ford may secure sole, unregulated possession of the greatest water power" in the South. The entire $83,175,475 expended and estimated as to be spent on the project should be made interest-bearing, Col. Cooper said, adding that the government was paying 4 per cent and more on the money it had borrowed.

Illinois Central R.R. Plans $50,000,000 Improvements

To provide funds for reconstructing its freight and passenger terminals and electrifying its lines in Chicago and for otherwise improving its property in that city the management of the Illinois Central Railroad Company will ask its stockholders at the annual meeting to be held on April 19 to authorize an issue of $50,000,000 preferred stock. Plans are now in preparation for the contemplated improvements which, it is expected, will be spread out over a period of eighteen years.

National Research Council Opens Fight on Marine Borers

An immediate investigation looking to an organized campaign against the activities of marine borers, or ship worms, is announced by the National Research Council, which has appointed to undertake the work a Marine Piling Committee consisting of:

R. T. Betts, chief engineer, Robbins-Ripley Co., chairman; George J. Ray, chief engineer, D. L. & W. R.R., vice-chairman; Dr. A. L. Barrows, assistant secretary, National Research Council, secretary; George M. Hunt, U. S. Forest Service; Prof. C. A. Kofoid, University of California, and Dr. Hermann von Schrenk, consulting engineer, N. Y. C. R.R.

Col. W. G. Atwood, has been appointed director for the investigation and will have his office in the Engineering Societies Building, New York City.

San Francisco Approves $2,467,000 Municipal R.R. Extension

At the Feb. 6 meeting of the San Francisco board of supervisors it was definitely decided to proceed with construction on the Duboce Ave. extension of the Municipal Ry. which will give direct access to the Sunset District. The total cost is to be $2,467,000 of which $1,900,000 is needed for a 4,200-ft. tunnel. Of the total cost, $1,967,000 is to be raised by assessments on property of the district and the city is to pay $500,000.

The primary object of the new extension is to pierce the Twin Peaks ridge and so open up the north Sunset region between Golden Gate Park and Parkside, much in the same way as Ingleside and St. Francis Wood were opened up by the Twin Peaks tunnel.

The proposal of better transportation for this district has been under consideration for four years. Recently four alternative routes were studied and reports were submitted on each by the city engineer who attached to his report, a recommendation in favor of the Duboce Ave. route. The boundaries of the assessment district are yet to be fixed, but it is understood that property owners who were assessed for the Twin Peaks tunnel will not be included in the new assessment.

Michigan Engineers Discuss Business Topics

Building Strike Prevention Measures Outlined — Sewer Reconstruction Needed—Drainage Laws

(Engineering News-Record Staff Report)

The Michigan Engineering Society, state assembly of the American Association of Engineers, is finding itself. A greater feeling of harmony among all members of the profession in the state was evident at the annual meeting, Feb. 8-10, at Kalamazoo, than has been observed at any time since A.A.E. went into Michigan. While all the irreconcilables have not joined, they are no longer belligerent. Tolerance is the watchword. Work, accomplishment, and a less radical feeling in the organization itself, have broken down many of the former barriers. The wholehearted way in which the local chapter has entered into the co-operation with existing organizations in Detroit to form the Associated Technical Societies has been no small factor. A minimum discussion of detailed engineering and a maximum amount of time spent on the business side of engineering characterized the program.

Scope of Program

The topics included ethics, co-operation in the building field, the highway situation, municipal problems, from zoning and planning to administration by the city-manager form of government, and the working of the registration law. There were inspirational addresses on vision and fellowship, and a mock court before which the chapters appeared to recite their achievements and receive a relative rating.

Perhaps the most interesting single feature to A.A.E. members over the country was the launching of the candidacy of Clarence W. Hubbell for the presidency of the national organization. Mr. Hubbell has recently resigned as city engineer of Detroit, effective March 1, to return to his consulting practice, having practically completed the carrying out of the sewer construction program for which he went into the office. Mr. Hubbell was a candidate last year but withdrew.

The assembly is growing; three new chapters were formed during the year at Pontiac, Kalamazoo and Jackson. Finances reflect the depression, but despite the fact that only 42 per cent paid their dues the assembly has money in the bank and the quarterly magazine made a substantial profit. Financial relations with headquarters, the greatest bone of contention a year ago all over the country, have apparently been straightened out satisfactorily.

"Engineering Ethics" by Dean M. E. Cooley, University of Michigan and president of the Federated American Engineering Societies, who could not attend because of a speaking tour in the Southwest, was treated by Prof. H. E. Riggs.

To Prevent Strikes

"Co-operation Between Architects, Engineers and Builders," a subject handled by Fred Larkin, president of the Association of Building Employers of Michigan, recounted methods which have prevented strikes in the state. The principal feature of the contractors' program, which champions the

American plan, was to call in all parties to any controversy, particularly the owner who paid the bills and the engineer or architect. Many specifications now have a clause requiring the contractor to use the American plan of employment and Mr. Larkin requested the engineers to insert it in all of their contracts. Actual costs during the past year have been 8 to 16 per cent lower in Michigan than elsewhere, but in many cases the wage scale was higher than the union rate.

Frank F. Rogers, state highway commissioner, outlined the progress of road building and indicated that the state's 1922 budget of $14,400,000 called for nearly 1,000 miles of trunk-line construction. Of this mileage about 275 miles will be hard surface and one-third will receive federal aid.

In the discussion of Prof. Arthur H. Blanchard's paper on "Highway Transport" it was brought out that the rural taxpayers need to realize that 68 per cent of the taxes for roads are paid by city residents. Gasoline taxes, he said are now levied in twelve states; many more are considering them and Prof. Blanchard stated that it was a reasonable measure of use taxation.

Prof. W. C. Hoad, University of Michigan, in his talk on "Sewer Surveys and Reconstruction" stated that growing cities all over the country are considering reconstruction because of outgrown systems. One of the greatest difficulties arises from the fact that sewers and sewage treatment often absorb more money than any other municipal utility and produce no revenue. He made a plea for the beautification of sewage works, grounds for the psychological effect upon attendants and citizens. In discussion, Patrick Keating, consulting engineer, Detroit, inquired as to why pure-iron corrugated pipe was not oftener used in comparatively temporary storm-water drains. No one seemed in favor of this expedient. To an objection to the high friction coefficient, N. R. Macklen, civil engineer, Bay City, replied that not much was known, but $10,000 was being expended at Berkeley, Cal., on hydraulic experiments on corrugated pipe.

Chapters in "Court"

In the recital of chapter activities before the "court," which was handled by L. E. Ayres, national director, A.A.E., the basis was a questionnaire of 30 questions relating to meetings, attendance, programs, civic activities, committees and financial operation by budget or otherwise. Reports were submitted by Ann Arbor, Detroit, Flint, Jackson, Kalamazoo, Lansing, Muskegon, Pontiac, Port Huron and Saginaw chapters and the districts of Grand Rapids, Bay City, Cadillac and the Upper Peninsula.

The report on the working of the registration law presented by C. R. Olmsted, office manager, State Board of Examiners, indicated 1,419 registrants, including 523 architects already registered under a previous law. The classification of engineers is as follows: Civil engineers, 595; mechanical engineers, 111; electrical engineers, 39; chemical engineers, 20; mining engineers, 50; marine engineers, 3, and surveyors, 143. Some engineers are classified in several of the classes. No work on violations has begun but the board expects to handle some clear-cut cases soon.

C. F. Lang Retires as President of Lakewood Company

Charles F. Lang has retired as president of the Lakewood Engineering Co., Cleveland, following a general reorganization which the company has undergone. Mr. Lang's retirement dates from the recent annual meeting.

Despite general business conditions reports from the field force of the Lakewood company indicate a general betterment and increase of business in all departments, particularly in the paving and general construction fields. It has already been necessary to increase the factory force to meet the improved demand.

Erie R.R. Awards Contract for Pier of Unusual Design

A contract for the construction of a freight pier at Weehawken, N. J. to replace one that burned last fall has been awarded by the Erie R.R. to Foley Bros. of St. Paul, Minn. The pier will be of two stories, 96 x 842 ft. in plan and will be divided into two equal sections by a transverse fire-wall. It will be served by two tracks and equipped with eight elevators.

The superstructure will be framed of Douglas fir designed in accordance with the slow-burning mill building principle and will be provided with automatic sprinklers. The sheathing will be of corrugated zinc and the gutters, leaders and window casings of plain sheets of the same metal. Zinc was selected for this purpose with a view to securing greater permanence than would otherwise be possible under the peculiarly corrosive conditions that result from the combination of salt air and locomotive gases.

Hold Conference on Highway Engineering at Michigan

The eighth annual Michigan conference on highway engineering was held at the University of Michigan, Ann Arbor, Feb. 13 to 17. The program, arranged by Prof. Arthur H. Blanchard, included papers and discussions.

Drainage legislation has been a thorn in the side of the engineering profession in Michigan for years. Drain commissioners are elected. Some are paid as high as $60 annually! Secretary Hunter, of the Michigan Association of Drain Commissioners, explained the difficulties and asked for—and obtained—an endorsement of legislation promulgated by his associates toward the establishment of a state drainage bureau under the agricultural department of the state.

Resolutions and Officers

Resolutions passed included a request for the appointment of committees to investigate motor bus and other highway transportation from the financial angle, to look into the question of a proposed state department of public works and to assist chapters in putting engineers in engineering positions.

The officers chosen for the ensuing year are as follows: President, L. H. Neilsen; vice-president, Ross J. Buck; treasurer, H. A. Shuptrine; director at large, Charles E. Wood. C. B. Huff, Detroit, the half-time secretary, was chosen by the board of directors.

Los Angeles Sewer Overflow Problem Serious

Objections to Nuisance from "Sewage Floods"—Flow Diverted into Creek Temporarily

The prediction of an early overcharge in the Los Angeles ocean outfall sewer, with resulting overflow and nuisance, made by the engineering department of the city in its report advocating the bond issue for a new sewer and sewage-works (voted down by the people last year) came true on schedule time and led to palliative measures on the part of the city that gave rise to protest and brought the matter before the State Board of Health. There was a public hearing before the board on Jan. 27, while on Jan. 31 residents of Culver City, Venice and other districts along Ballona Creek applied for an injunction to prevent Los Angeles from continuing the Ballona Creek discharge.

From statements made at the Board of Health hearing it appears that the capacity of the trunk sewer conveying city sewage to the ocean has been overtaxed to such an extent that the daily peak flow in the sewer is sufficient to put the main line under pressure and cause the sewage to escape from the manholes in certain residential districts.

Release Flow Into Creek

As an expedient to prevent this nuisance the city tapped the trunk sewer and released a flow of about 10,000,000 gal. daily into Ballona Creek, whence it finds its way to the ocean near Venice. Until a permanent means of disposal can be provided the city proposed to put in a temporary screening plant at the point where the sewer was tapped and after screening to chlorinate the effluent. It was estimated that about 18 to 20 per cent of the solids could be removed in this way and the bacterial count reduced about 90 to 95 per cent. The State Board of Health refused to sanction the discharge of sewage into the creek, even with treatment, as outlined.

Property owners in the residence districts subject to the sewage floods vigorously defend the Ballona Creek relief measure. Residents of the area along the watercourse as vigorously protest. The city engineer believed that the only permanent solution is the voting of bonds for a disposal plant or new outfall to the ocean.

Asphalt Association Opens Branch Office at Albany

In line with its recent action in opening branch offices at Raleigh, N. C., and Atlanta, Ga., the Asphalt Association, New York City, carrying out its policy of expansion, has moved its Canadian office from Toronto to Albany, N. Y., where Germain P. Graham, formerly deputy city engineer of Albany, will be in charge as district engineer.

Mr. Graham graduated from Rensselaer Polytechnic Institute in 1908 as a civil engineer. From 1909 to 1917 he was in the city engineer's office at Albany where he had charge of river front improvement and intercepting sewers. During the World War he served as Captain and Adjutant in the 20th Engineers. At the conclusion of his army service he returned to Albany as deputy city engineer.

Propose $5,000,000 Bond Issue for Norfolk Port

A proposed bond issue of $5,000,000 by the City of Norfolk, Va., for the construction of waterfront improvements, was passed, 6 to 1, by popular vote Feb. 7, 1922. The preliminary plans provide for piers and sheds with 500,000 sq.ft. of warehouse space, two open pier berths and a grain elevator of 750,000 bu. capacity with a berth to serve it, at a total cost of approximately $3,800,000. The remainder of the proposed appropriation is for the establishment of a sinking fund for maintenance, etc.

Memphis To Build Subway Under Railroad Tracks

Mayor Paine of Memphis, Tenn., has reached an agreement with the Nashville, Chattanooga & St. Louis R.R., the Frisco R.R., the Southern R.R., Union Railway, and the Louisville and Nashville R.R. under the terms of which a subway will be constructed under the tracks of these five railroads where they cross South Bellevue Boulevard. Negotiations have been under way for more than two years between Memphis and the railroads in an effort to agree on building the subway.

The estimated cost of the subway is $300,000, of which 80 per cent will be paid by the railroads and 20 per cent by the city. Plans will be rapidly completed so that work can start by the middle of 1922. About a year will be required to complete the subway. Reinforced concrete will be used and the street approaches will be widened to 60 ft., the present street being only 45 ft. The Memphis Street Railway will extend its tracks under the subway and connect the southern part of Memphis with the northern section.

Memphis was granted power by the last state legislature to sell bonds to pay for its share of the cost.

Middle West Practising Engineers Form New Association

At a conference Jan. 18 of practising engineers from Iowa, Nebraska and South Dakota, held during the convention of the Iowa Engineering Society at Sioux City and sponsored by the Iowa Section of the American Society of Civil Engineers, it was decided to form a new association with membership limited to engineers either wholly or in part in private practice. The objects are similar to those of the American Institute of Consulting Engineers.

To raise the standards of ethics of the profession, to bring about a higher degree of professional co-operation between the engineers of every state and to perfect the standard contracts for engineering services are some of the immediate problems it is proposed to attack. One suggested name is the Missouri Valley Association of Engineers. Engineers from Illinois on the east, Colorado on the west, Kansas on the south and Minnesota and North Dakota on the north are to be asked to support the association.

The temporary officers elected to lay the groundwork for the proposed assotion are as follows: President, Prof. John H. Dunlap; vice-president, George T. Prince; secretary-treasurer, E. K. Mather, Mitchell, S. D.

Frank Chittenden Osborn

Frank Chittenden Osborn, founder of the Osborn Engineering Co., Cleveland, Ohio, died suddenly at his home in Cleveland Jan. 31, as reported in last week's issue. He was born in Greenland, Mich., in 1857 and after graduation from Rensselaer Polytechnic Institute, entered the employ of the Louisville (Ky.) Bridge Co. as assistant engineer. In 1885 he became principal assistant engineer for the Keystone Bridge Co., of Pittsburgh, Pa., and in 1887 joined the firm of G. W. G. Ferris & Co., inspectors and designers of structural-steel work in that city. In 1889 he accepted the position of chief engineer of the King Bridge Co., of Cleveland.

Foreseeing a wide field as a private practitioner, he resigned in 1892 and proceeded to establish an engineering practice which grew to such proportions that in 1900 it was incorporated as the Osborn Engineering Co. The Osborn Company designed and constructed nine portland cement plants, with a producing capacity of about 17,000 barrels of cement each day, a large number of bridges of steel and reinforced concrete for counties, cities, electric and steam railways.

In 1908 Mr. Osborn was appointed a member of the Cuyahoga County Building Commission, having charge of the construction of the new court house at Cleveland, involving an expenditure of about $5,000,000.

He was an active member of the Cleveland Engineering Society, and had been director, secretary, vice-president and president, and at the time of his death was a member of its City Plan Committee. He was for three years (1901-03) a director of the American Society of Civil Engineers and in 1909 he was appointed a member of its Special Committee on Steel Columns and Struts, and served on this committee for several years. He was a member of the Association of Railway Superintendents of Bridges and Buildings, American Society of Testing Materials, and the Institution of Civil Engineers of Great Britain.

South Carolina Proposes Big Road Improvement

A proposal to spend $34,000,000 within six years and to complete within that time 4,000 miles of the state highway system, more than 600 miles of which would be hard-surfaced and the remainder surfaced with sand-clay, top soil, or gravel, is to be urged before the present session of the legislature of South Carolina. In order that this proposal should conform to the federal-aid acts the state highway officials recently held conferences with representatives of the U. S. Bureau of Public Roads.

If this greatly expanded program is carried out, the state will match all of the federal-aid money now available and any future appropriation that may become available. Funds will be raised by automobile licenses, by continuing the state-wide 2-mill property tax, a 1-cent-per-gallon motor fuel tax, and a bond issue of $10,000,000.

Santa Fe Ry. Plans Improvements To Cost $45,000,000

The budget of the A., T. & S. F. Ry. System for 1922 contemplates the expenditure of about $45,000,000 for improvements, betterments, equipment, double-tracking and new branch lines, as compared with $35,000,000 in 1921. According to W. B. Storey, president, prospective demands of the territory served by this system would call for a much more extensive program, probably $60,000,000 annually for three years, but such an outlay is not possible under present conditions.

Of the 1922 expenditures, $11,750,000 will be for the completion of work in hand; $22,000,000 for new work, including 75 miles of new second track from Yampai to Griffiths, Ariz.; $8,000,000 for new equipment; $1,400,000 for a 55-mile branch from Satanta, Kan., and $1,150,000 for a 35-mile branch from Owen to Pawhuska, Okla. In the construction of the Arizona second track there will be a grade reduction from 95 ft. to 75 ft. per mile, which will save from 20 to 25 per cent in freight train mileage, amounting to upwards of $500,000 a year.

Following are some of the larger items in the budget:

Addition to main lines	$6,662,298
New branch lines	2,550,000
Bridges, trestles and culverts	1,512,893
Rails and other track material	1,101,868
Stations and office buildings	1,056,639
Shop buildings	1,041,350
Additional yard tracks and sidings	946,148
Shop machines and tools	724,281
Assessments for public improvements	533,633
Widening cuts, fills, etc.	459,701
Signals and interlocking plants	466,288

A. A. E. Employment Survey Finds Conditions Improving

That the demand for engineering services is on the road to recovery is reported by the employment department of the American Association of Engineers, which has received reports from more than 200 widely separated localities. Many million-dollar projects are in progress or contemplated at an early date. Although a lull in engineering employment was experienced at the end of the year, the number of unemployed was less than it had been for several months. The following table shows the trend of employment:

	Dec. 1921	Nov. 1921	Dec. 1920
Applicants for employment	1877	1661	1915
Positions received	308	335	645
Men referred	1397	1639	3615
Men placed	175	193	269

The average monthly salary of positions filled in December was $178 or $14 less than the month previous. For the same month last year the average salary was $200. The highest salary position filled was $6,000 per annum; the lowest salary $90 a month.

The greatest number of engineering positions was in the East and the South Atlantic states. The principal demand was for engineers in designing offices, with architectural firms coming first. There was a small demand for construction engineers and general outside men. Most of the men unemployed are engineers with railroad experience, a field which has been inactive for some time. The main demand at this time is for highway engineers designers, sales engineers and a fair demand for mechanical engineers.

Transit Line's Value $465,680,154

As a preliminary to the proposed unification of the transit system of New York City the Bureau of Valuation of the Transit Commission has announced a valuation of $465,680,154 for the operating properties of all of the transit companies in the city. This amount is less than had been expected, the companies' own valuation of the properties being $791,450,839.

Load Limit in Shasta County

Shasta County, Cal., has recently enacted an ordinance limiting loads that may be hauled over the roads from Nov. 1 to April 1 to 5,000 lb. weight of the vehicle included.

The Supervisors have given the Pacific Gas & Electric Co. a permit to exceed that limit, but it has to give a bond of $2,000 that all damage to the roads and bridges will be made good immediately, and it undertakes to guarantee that no heavily laden trucks will go on the roads during a storm or immediately after a heavy rain.

Baltimore May Convert Reservoir Into Municipal Stadium

A favorable report on the conversion of the Mount Royal reservoir of the Baltimore water-works into a municipal stadium has been made by Henry G. Perring, chief engineer of the Department of Public Improvements of that city. At a conference held by the Mayor of Baltimore, William F. Broening, recently, at which members of the Public Athletic League of Baltimore and other interested citizens were present, unanimous support was given to the project.

The reservoir, 550 ft. in diameter, was built 70 years ago for low service but its use was given up ten years ago. Mr. Perring proposes to remove the cobblestone lining of the inner slope and construct concrete seats. The cost of five different schemes, designed to seat from 14,000 to 60,000 people, is estimated at from $100,000 to $375,000 with a possibility of seating 70,000 at an estimated cost of $500,000. These costs cover structural requirements, no allowance having been made for architectural features that may be added later.

Associated Industries Establish Technical Information Service

The executive committee of the Associated Industries of Massachusetts recently voted to establish a technical information service. The technical adviser named to conduct the department is Hervey J. Skinner, of the firm of Skinner, Sherman & Esselen, Inc., chemists, biologists and engineers, Boston.

The new section will answer inquiries on fundamental processes employed in manufacturing operations and will supply members with information relating to problems of construction, properties of building materials, selection of more important types of equipment for specific operations, erection of machinery, and the like. It is also in a position to direct members to sources of information on technical subjects, and to places where materials or equipment can be obtained to the best advantage.

Indiana Adopts Lugless Brick and Asphalt Filler

The state highway commission of Indiana, through Lawrence Lyons, director, has just announced a radical change in specifications for vitrified brick pavements. Under the new specifications, the state, while continuing the construction of rigid base, permits the change from a rigid to a flexible brick surface by specifying asphalt filler.

Previous to the change, Indiana's brick specifications called for monolithic construction. The new specifications call for a 5-in. concrete base, 1-in. cushion, 3-in. brick and asphalt filler.

15 States Tax Gasoline

Figures Issued Feb. 15 by the National Automobile Chamber of Commerce show that 15 states now have a tax on gasoline. Two cents a gallon is the charge in Oregon while a 1-cent-a-gallon tax is collected in Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Kentucky, Louisiana, Montana, New Mexico, North Carolina, Pennsylvania, South Dakota, and Washington.

Gasoline-tax bills are impending in six other states—Massachusetts, Maryland, New Jersey, South Carolina, and Virginia—the amounts varying from 1 to 3 cents per gallon.

Super-Power Advisory Board To Meet

Now that ample time has been given to secure the reactions of the electrical industry to the super-power report, the members of the Advisory Board are to be called together in the near future for further discussion of the project.

Dr. George Otis Smith, the director of the U. S. Geological Survey, under whose direction the super-power report was prepared, believes that the showing of economies presented in the report has stimulated interconnection between existing systems throughout the country The nation-wide interest that has been taken in the report is indicated by the fact that the entire edition of 10,000 copies of the report has been exhausted. The exact date of the meeting of the Advisory Board had not been fixed.

Secretary of Commerce Hoover states that the super-power report has stimulated the desire for similar studies in the Pittsburgh-Chicago area and in other sections.

Indiana Announces Bridge Plans

The bridge program of the Indiana state highway commission for 1922 which includes new structures and the repair of many old ones, embraces fifty-five state-aid projects, and sixty-five federal-aid jobs. All are to be grouped into six divisions with a resident engineer in direct charge of each division.

The state aid bridge projects, to cost $370,000, are situated in twenty-six counties. The smallest project is a 16-ft. span and the largest a 600-ft. crossing of six spans. The latter is a viaduct over the Big Four Railroad tracks west of Covington.

Of the sixty-five federal-aid bridge projects the smallest is a 20-ft. span, and the largest an 1800-ft. crossing. The latter is the bridge across White River at Hazelton.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Society Meeting, Dayton, Ohio, April 5-6; Subject, "Flood Problems."

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

The New York Section of the American Water Works Association will hold its last regular meeting until the fall on Thursday, March 2, at 12:30 p.m. The speaker will be Beekman C. Little, superintendent of the Rochester water-works and past president of the association.

The Colorado Society of Engineers has elected the following officers for the ensuing year: President, R. M. Hosea; vice-president, W. M. McMechem; and secretary-treasurer, C. M. Lightburn.

The Engineers' Club of Philadelphia will hold a joint meeting with the following societies on March 6, at the clubhouse: Am. Soc. C. E., Illuminating Engineering Society, Am. Soc. M. E., and the American Society of Municipal Engineers. The subject for discussion will be, "Zoning and Its Relation to City Development."

Personal Notes

THOMAS BOLES, chief engineer of the Fort Smith & Western Ry., has been appointed superintendent of the government reservation at Hot Springs, Ark.

HERBERT TALLEY, chief engineer of the Hercules Powder Co., Wilmington, Del., has resigned to become an executive of the United States Powder Co., Terre Haute, Ind., in which company he is financially interested.

PERRY O'NEIL, until recently president of the O'Neil Engineering Co., of Dallas, Tex., is now representing the Elrod Engineering Co., of Dallas, and Los Angeles, Cal., as contracting engineer.

B. L. G. REES, civil engineer, has joined the advertising selling staff of *Engineering News-Record*, and will operate in the New York territory. He was graduated from Princeton in 1907 and after serving in the engineering department of the Pennsylvania R.R. for several years he engaged upon the New York Barge Canal work, which he left to take up harbor terminal construction at Brunswick, Ga. Subsequent engagements were on the New York subways; at Antofagasta, Chile,

on nitrate developments; and, during the war, on construction work at Camp Merritt and the Port Newark terminal. Recently Mr. Rees was civic manager for the city of Nitro, W. Va., for the Charleston Industrial Corp.

WILLIAM P. GRAHAM, formerly dean of the L. C. Smith College of Applied Science, Syracuse University, has been appointed acting vice-chancellor of the university. LOUIS MITCHELL, professor of civil engineering, will succeed Mr. Graham as dean.

F. J. NEVINS has been appointed valuation engineer of the Chicago, Rock Island & Pacific Ry., with headquarters at Chicago.

WILLIAM H. HOFFMAN, until recently structural engineer for the Case Crane and Engineering Co., Columbus, Ohio, has become chief engineer of the Hughes-Keenan Co., at Mansfield, Ohio.

ARTHUR ST. LAURENT, assistant deputy minister of the Canadian Department of Public Works, has been appointed chief engineer, succeeding the late E. D. Lafleur.

JOHN MACCUTCHEON has been appointed superintendent of bridges for Bridgeport, Conn.

LYMAN T. BANKS, formerly steel expert of the U. S. Shipping Board, has been elected secretary of the Engineers' Club of Seattle.

ARLINGTON M. SMITH, EVAN FISHER, HENRY R. HAINES and HENRY FISHER, JR., who have been connected with the construction department of the Southern California Edison Co., have left that organization to open offices in Bakersfield, Cal., under the name of Western Engineering Co. Special attention will be given to construction and supervision of mining, irrigation and hydraulic work.

CHARLES F. PUFF, JR., has resigned his position as secretary and general manager of the associated Pennsylvania Highway Contractors to engage in the private enterprise of establishing the contractors Service Bureau, covering a territory within a 30-mile radius of Philadelphia. At a special meeting of the board of governors resolutions were passed expressing regret at Mr. Puff's loss to the association and appreciation of his services. Mr. Puff, before becoming associated with the Pennsylvania contractors organization, was assistant chief engineer of the highway department of Philadelphia.

JAMES M. FOURMY has been appointed state highway engineer of Louisiana. He is a graduate of the Louisiana State University, class of 1905, and has been engaged in highway work within the state for the past 10 years. Before he entered the highway field he planned and supervised the building of the electric railway to the top of Signal Mountain, near Chattanooga, Tenn. and later served as assistant city engineer of New Orleans.

W. F. COOPER, who has been with the Louisiana State Highway Department since 1917, has been appointed assistant state highway engineer, with headquarters at Baton Rouge.

PHILLIP DEAN, building commissioner for Madison, Wis., has resigned to enter private practice as an architect and engineer in Madison.

P. T. ROBIN, formerly connected with the Terry Manufacturing Co. in New York as sales and cost engineer, has been appointed contracting engineer for the Penn Bridge Co. at the New York Branch.

A. H. ROBBERT, formerly chief designing engineer for the Terry Manufacturing Co. in New York, has joined the staff of the Penn Bridge Co. as contracting engineer for the New York Branch.

WILLIAM CRAVEN, bridge engineer, North Carolina State Highway Commission, has been appointed senior bridge engineer.

W. F. COCKE, assistant state highway engineer of Virginia, has resigned to become state highway engineer of Florida.

W. H. DE FRANCE, who has been with the Texas & Pacific R.R. for the past few years, has been appointed superintendent of wharves and docks for the Board of Park Commissioners, New Orleans, La., succeeding Hayden Wren, resigned.

J. F. MALINE, engineer and vice-president of the E. F. Hauserman Co., Cleveland, Ohio, has been appointed Director of Public Service for Cleveland by Mayor-elect Kohler.

W. RICHMOND TRACY has been elected engineer-secretary for the Union County Park Commission, with headquarters in Newark, N. J. Mr. Tracy is at present engineer in charge of bridge construction for the Bronx Parkway Commission.

GEORGE F. SYME, supervising engineer, North Carolina State Highway Commission, has been appointed senior highway engineer.

OBITUARY

WILLIAM C. SARGENT for 22 years secretary and also a director of the Chain Belt Co., Milwaukee, Wis., died suddenly Feb. 5. He was 73 years of age.

JOHN G. TAIT, contractor, of Lima, Ohio was killed in an automobile accident, Feb. 14. At the time of his death Mr. Tait was manager in Ohio for the Willite Construction Co. He had served formerly on the construction of the Hudson River tubes in New York.

RICHARD R. RICE, manager of the Lynn (Mass.) works of the General Electric Co., died suddenly at Lake George, N. Y., Feb. 10. He was a graduate of Stevens Institute of Technology (class of 1895) and specialized in the design of steam turbines and engines.

R. M. DEGARMO, assistant engineer on the Florida East Coast Ry., died Feb. 14 at Key West, following injuries received when the railway motor car in which he was inspecting structures over the Florida Keys became derailed. Mr. De Garmo was thirty-six years of age, a graduate of Cornell University, and a member of the American Society of Civil Engineers and the American Association of Engineers. Mr. De Garmo served with the 17th Engineers overseas, first as a first lieutenant and then captain and major, respectively, serving under Col. C. S. Coe. He had been connected with the Florida East Coast Ry. since September, 1909.

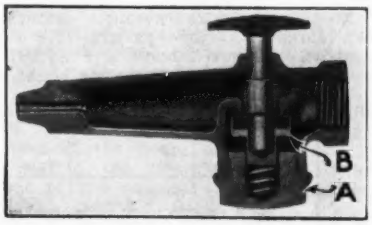
BUSINESS NOTES

THE PENN BRIDGE CO., with main offices at Beaver Falls, Pa., and shops at Claysville and Beaver Falls, will open a New York branch office on March 1 at 101 Park Ave., with P. T. Robin and A. H. Robbert as contracting engineers, in charge. The company's bridge and structural work in the east will be taken care of by the new branch and all the crane and derrick business formerly carried on at Beaver Falls will be transferred to New York. The Penn Bridge Co. was recently awarded the contract for the construction and erection of a Strauss trunnion bascule bridge over the Shark River Inlet between Avon and Belmar, Monmouth County, N. J.

EQUIPMENT AND MATERIALS

Air Gun With Renewable Valve Disk

Air waste is eliminated, in a new air gun developed by Jenkins Bros., New York, by means of a renewable disk



with which the valve is fitted. In the illustration the disk, a ring through which the valve stem passes, is indicated by the dark shading. To replace the disk the cap *A* is unscrewed and the disk holder *B* is removed through the opening. The air gun is cast brass.

Improved Pneumatic Spade

To reduce failure by fatigue, the Chicago Pneumatic Tool Co., New York, has developed a special design of pneumatic spade. The spade and shank complete are forged from a solid piece of steel and reinforced on the inside at the point of the shank connection to the blade, thus insuring impact of blow straight through to the point of the blade, and eliminating to a large degree force components, that may produce fatigue and cause the shank to break. The back of the spade has a curvature, so calculated from experiments, as to reduce digging friction to a minimum and permit easy and accurate guiding. Another feature is the retaining device fitted with a spring shock-absorber, which absorbs the shock occasioned by the piston striking the spade shank when the spade is not against the clay. The spring has been so arranged it will absorb more energy than the piston develops.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Harding Sees Cause for Optimism in Treasury Statement

"The most satisfactory turn in the financial affairs of the country since the conclusion of 1919" is the view taken by President Harding in a recent statement issued from the White House which comments upon the report of the Controller of the Currency based on the last bank call—that of Dec. 31, 1921. The President reviewed some of the most important of the statistical points in the Controller's report, concluding that the peak of liquidation had been passed some time between Sept. 6, and Dec. 31, 1921. The bank call of the national banks showed that, between these two dates the cash in vaults was reduced only by $15,987,000; that, excluding government deposits there was an increase of $322,811,000 in individual deposits, whereas they fell over $1,500,000,000 during the nine months previous to Sept. 6, 1921; and that the national banks had lawful reserve with Federal Reserve Banks of $1,143,000,000, or $87,000,000 in excess of legal requirements.

The Controllers' statement shows a considerable increase in available resources. Improved banking conditions are also evident, especially as regards rediscounts and cash on hand. Deposits have also shown surprising gains. Payments on some of the outstanding "frozen credits," may be realized.

Next week a cement manufacturer discusses uniform bids.

How High Are Cement Prices?

Compared with Steel, Lumber and Common Labor from 1913 to Date

Eight of the Middle West state highway departments have put a boycott on the purchase of cement for road work, declaring that the price of cement must be brought down "in harmony with the reduced price now in effect for all other basic commodities." This action prompts the inquiry whether cement prices are high and also demands a comparison with the price fluctuations of other construction materials.

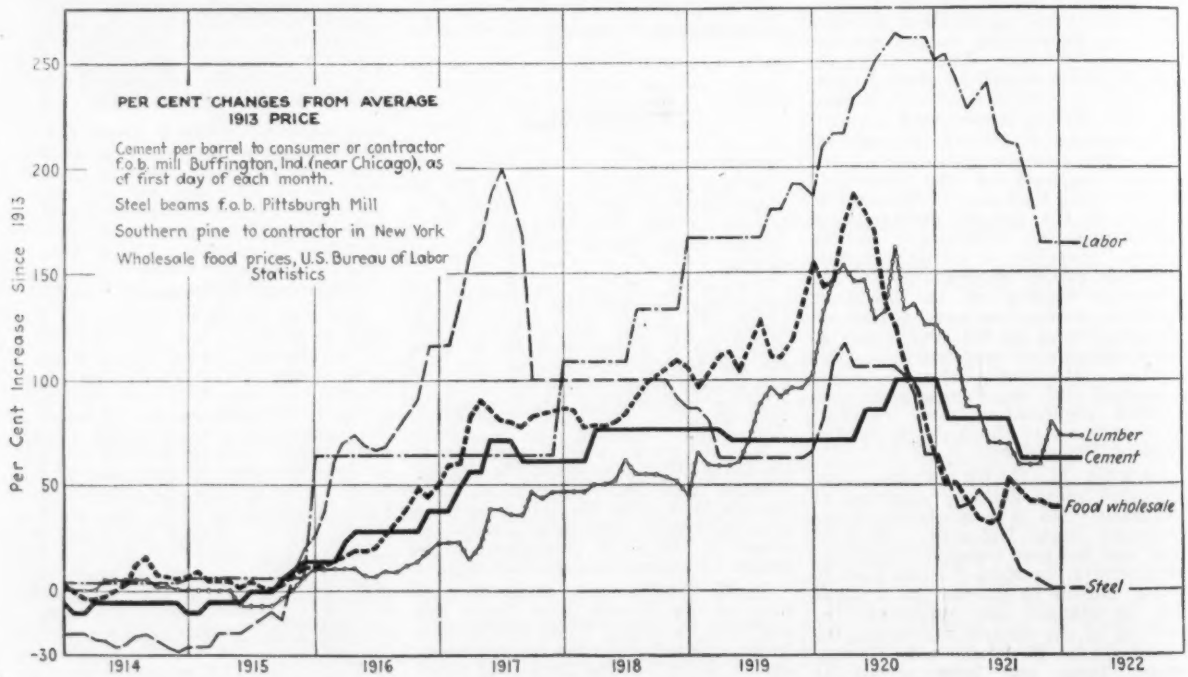
The showing in the case of cement is apparently unfavorable upon this basis. It does not take into consideration the extent to which these materials increased in price at the peak from their 1913 basis. It is conceivable that one of them might have increased to a very much greater extent than others and consequently be under the necessity of falling by a greater amount than the others. To be able to judge of the fairness of construction material prices today, comparison should be made not merely between the price drops from the peak between the present level and that of 1913. Table II shows in detail the changes in cement price of each year from 1913 to date.

TABLE I. PRICES OF PRINCIPAL CONSTRUCTION MATERIALS AND COMMON LABOR COMPARED

	Today	Six Months Ago	One Year Ago	Peak 1920	Per Cent Decline Since Peak
Cement, Chicago	$1.97	2.17	$2.00	$2.37	17
Cement, mill	1.70	1.70	1.80	2.10	19
Steel, Pittsburgh	1.50	1.85	2.70	4.00	62
Lumber, New York	49.00	45.00	66.00	72.00	32
Labor, United States	0.45	0.53	0.53	0.62½	28

Comparisons with prices of steel, lumber and labor, which, in addition to cement, are the basic factors in construction costs are made in Table 1. This shows basic prices of cement at mill and f.o.b. city; steel shapes at mill; lumber f.o.b. city, and the average common-labor rate for the country. The prices given are those now current, prices six months and a year ago, at the peak in 1920, and the per cent price decline since the peak. In all cases the price of cement is *exclusive of bags.*

Comparison of the price movements of cement with the price trends of steel, lumber and labor is possible by Table III. Here are given the yearly average prices of these materials and the per cent change from the 1913 level for



PRICE TRENDS OF PRINCIPAL CONSTRUCTION MATERIALS AND THE WHOLESALE COST OF FOOD AS PERCENTAGES OF 1913 PRICES

each. It will be seen that steel—the distinctly war material—beginning at $1.50 per 100 lb. in 1913, did not exceed this figure until 1916 when it shot up to $2.55, continuing up to $3.70 for 1917. Government regulation then fixed the price at $3. Since 1920 the descent has been rapid, to the present low level of $1.40@$1.50. Steel rose to a maximum of 147 per cent above the 1913 price and is now 7 per cent below that price.

TABLE II. PRICES OF CEMENT AT MILLS AND F.O.B. CHICAGO WITH PER CENT CHANGES FROM 1913

	All Mills		Midwest Mill		F.O.B. Chicago**	
	Average Price	Per Cent Change	Average Price	Per Cent Change	Average Price	Per Cent Change
1913	1.005	..	$1.05	..	$1.19	..
1914	0.927	−8	0.99	−6	1.14	−4
1915	0.860	−14	1.04	−1	1.16	−2
1916	1.103	10	1.32	26	1.44	21
1917	1.354	35	1.66	58	1.75	47
1918	1.598	59	1.81	72	1.97	66
1919	1.71	70	1.80	71	2.01	69
1920	2.01	100	1.94	85	2.01	69
1921	1.87	86	1.85	76	2.14	80
1922	1.83*	82	1.70	62	1.97	66

*Average of *News-Record's* mill quotations since Jan. 1.
** Necessarily includes freight between mill and Chicago. Consequently these two columns are affected by the freight increases.

Lumber, at $28.50 per M. ft. b.m., for Southern pine in New York in 1913, began to rise rapidly in 1916, reaching a peak of $70@$75 in 1920. There was little decline until 1921, when $45 was quoted September to November. The market strengthened in December, 1921, and now stands at $49 to contractors. The peak was 153@162 per cent and the price now is 72 per cent above 1913 level.

Labor reached a maximum in September, 1920, when the average rate of common labor was 62½c. per hour or 264 per cent above the 1913 level. Since then the rate has declined to 45c., which is 162 per cent above the 1913 level.

Further light could be thrown on the situation by comparing cement with still other construction materials. In general the prices of brick, sand, gravel and crushed stone are high, and their increases over the 1913 level are comparable with that of the cement price.

It is apparent, therefore, that while the price decline of cement from the peak is not as great as that of other building materials, the present price level is at the same height above 1913 as those materials except steel, which was affected by special conditions.

Bituminous Prices 83 per Cent Above 1913 Level

In connection with the leading article in this section, "How High Are Cement Prices?," it is interesting to note that the average spot price of bituminous coal is $2.22 at mines, against $1.22 for February, 1913. The peak was in August, 1920, when the average price was $9.51. The price one year ago was $2.77. *Coal Age's* indices of bituminous coal prices, are as follows: Yearly averages; 1913, 102; 1914, 94; 1915, 91; 1916, 152; 1917, 269; 1918, 213; 1919, 214; 1920, 466; 1921, 211; Feb, 13, 183; 1920 peak, 786.

Car Loadings Show Gain

Due to increased traffic, principally in coal and merchandise and miscellaneous freight which includes manufactured products, loadings of revenue freight totaled 753,886 cars during the week which ended on February 4, compared with 743,728 cars during the previous week or an increase of 10,158 cars. This was 54,168 cars in excess of the corresponding week in 1921 but 8,794 less than were loaded during the corresponding week in 1920.

Loading of merchandise and miscellaneous freight amounted to 429,705 cars, an increase of 9,295 over the preceding week and 26,944 more than were loaded during the same week last year.

TABLE III. PRICES OF STEEL, LUMBER AND LABOR WITH PER CENT CHANGES FROM 1913

	Structural Steel—Pittsburgh Mill		Southern Pine—New York		Common Labor	
	Average Price	Per Cent Change	Average Price	Per Cent Change	Average Rate	Per Cent Change
1913	$1.50	..	$28.50	..	0.171	..
1914	1.15	−23	29.00	2	0.177	4
1915	1.30	−13	28.00	−2	0.182	6
1916	2.55	70	31.50	11	0.281	64
1917	3.70	147	37.75	32	0.281	64
1918	3.00	100	43.25	52	0.380	122
1919	2.55	70	50.00	75	0.466	172
1920	2.95	97	67.50	137	0.579	238
1921	1.95	60	51.50	81	0.542	217
1922	1.40	−7	49.00	72	0.45	162

Coal shipments totaled 185,151 cars, a gain of 4,185 over the week before. This was 27,597 more than were loaded during the corresponding week in 1921. It was, however, 9,212 less than were loaded during the corresponding week in 1920.

Forest products also showed a gain over the week before of 2,831 cars, the total being 50,204 cars. It was, however, approximately 2,500 under the same week last year and about 10,000 below the corresponding week in 1920. Coke shipments totaled 7,844 cars, an increase of 342 over the week before but 1,678 below one year ago.

Shipments of grain and grain products amounted to 48,969 cars, a decrease of 1,911 compared with the previous week but an increase of 11,948 over the same week last year and 14,376 greater than the same week in 1920. Live stock shipments also decreased 4,592 cars compared with the week before, bringing the total to 27,998.

According to reports of the Car Service Division of the American Railway Association, idle freight cars totaled 467,997 for Feb. 8 as against 489,842 on Jan. 31; or 21,845 fewer idle cars this month than last.

To Penalize Those Who Disregard Jurisdictional Dispute Awards

The Associated General Contractors of America, the American Institute of Architects, the Engineering Council, the National Building Trades Employers' Association, and the Building Trades Department of the American Federation of Labor, through the National Board for Jurisdictional Awards which has just concluded its regular quarterly meeting in Washington, have reached an agreement, expressed in resolution form, heavily penalizing union workmen who refuse to abide by the decisions of the Board.

The resolution provides that local building trade councils of union labor shall suspend and refuse to recognize those unions which refuse to abide by decisions of the board; that general contractors and sub-contractors who employ only union labor shall incorporate in agreements with labor provisions that will secure compliance with all the board's decisions; that employment shall be refused to members of local unions who disregard such decisions; and that architects and engineers shall insert in specifications and contracts a clause that the decisions of the board shall be followed. The resolution signed by the various organizations came as the result of the non-conformance to decisions of the board on the part of the United Brotherhood of Carpenters and Joiners of America.

Of the seventeen international unions that constitute the Building Trades Department of the American Federation of Labor, sixteen have endorsed the work of the board and supported its decisions, the carpenters alone, though one of the original organizers of the board, refusing to support it. As a result, the carpenters have been suspended from the Building Trades Department and have been outlawed by every building trades council and the leading organizations of general contractors, sub-contractors, engineers and architects.

Trend of Business

Bonds—Announcement that Victory 3¾s would be redeemed in May was expected to bring forth heavy offerings of other kinds of bonds. On the contrary offerings were surprisingly light last week. Municipals firm but inactive.

Foreign Exchange continues to advance. Sterling, $4.37⅜; Canadian dollar, 96c.; German mark 0.48½c.

Steel—New low price on structurals, $1.40, against $1.50 in 1913.

Employment—For 106 iron and steel establishments reporting to the Bureau of Labor Statistics the combined January, 1922, payroll numbers 21.5 fewer men and amounted to only 44.9 as much money, as for January, 1921. Nine industries show greater payrolls, five report a decrease.

Retail food prices were 5 per cent cheaper in January than in the preceding month. Prices were 44 per cent above the 1913 schedule, which is 18 per cent less than a year ago.

B. F. Goodrich Co. showed a net operating loss of $76,670 for 1921, compared with net profits of $7,756,626 in 1920.

Large Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 71@81, are the following large projects: Rebuilding one of four piers along the Hudson River at Weehawken, N. J., to Foley Bros., 209 Gilfillan St., St. Paul, Minn., $1,000,000; paving streets in Norfolk, Va., to F. J. McGuire, Paul-Gale-Greenwood Bldg., $238,210; paving 2nd St., Duluth, Minn., to D. H. Clough & Co., 707 East Superior St., $237,837; a 10-story office building at Washington, D. C., to R. P. Whitty, Union Trust Bldg., $750,000; 40,000,000 gal. reservoir at Detroit, Mich., to W. C. Wood Co., 1805 Ford St. $687,580.

Private Garbage Collection for Salt Lake City

Salt Lake City recently entered into a contract with the Plymouth Stock Company by which the city is to pay the company $13,500 per year for the collection of residential garbage, heretofore collected by the city. The garbage is to be delivered at the old union stock yards.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 71@81 are the following:

A high school at Des Moines, Ia., $1,100,000.

A bank and office building at Indianapolis, Ind., $1,000,000.

A road improvement project in Ohio, $380,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 2; the next, on March 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	—$3.25	$4.00	$2.63	$2.91	$3.50	$3.10	—$3.25	$4.00
Structural rivets, 100 lb	3.50	—3.80	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	—3.15	3.50	2.53	2.81	3.42½	2.75	—3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	—68%	45%	57%	61.9–5%	44%	—58.8%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	—37.63	48.30	40.60@42.60	46.00	52.00	—48.00	45.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	—2.39	2.40	1.97	2.24	2.90	2.73	2.94	3.10
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.00	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	—1.90	2.93	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	57.00	34.00	44.00	38.00	50.00	—31.00	20.00	.....
Lime, finishing, hydrated, ton	15.80@16.80	—18.00	25.00	18.00	29.00	24.00	22.00	27.00	26.00
Lime common, lump, per bbl	2.75@3.48	—1.25	—2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	21.40	8.50	11.00	11.00	15.00	14.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	.13	.0821	.0752	.08	....	.10	.08
Hollow partition tile 4x12x12, block	.11120	.0675	.13	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.87	+.96	.93	+.89	+1.01	+1.14	+1.04	.86	.82
Common Labor:									
Common labor, union, hour	.60	.35	.....	.72½	.....	.50@.55	.62½	.50@.60	.....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.40@.50	.35@.40	.43¾@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5¼ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 95.8 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Pittsburgh mill price on structural steel shapes, plates and bars continues at $1.40@$1.50 per 100 lb.; the smaller figure applying principally to lots of 100 tons or over. Mill shipments, New York, of shapes, plates and bars are quoted at $1.78@$1.88. Mill shipments, Denver, of structural shapes are quoted at $2.75 per 100 lb. Steel shapes are quoted in Atlanta at $3.25 as against $3.50 and in Seattle at $3.25 as compared with $3.36 per 100 lb. one week ago.

Substantial reductions in cast-iron pipe, wrought steel pipe and reinforcing bars quoted in Atlanta and Seattle warehouses. Atlanta also quotes a reduction of 16c. per bbl. on cement; 10c. per cu.yd. on crushed stone; $1 per ton on hydrated finishing lime and 25c. per bbl. on common lump lime. Dallas quotes common lump lime at $2.50 as against $2.75 per bbl. (180-lb. net).

Douglas fir down $1 per M. ft. in San Francisco. Increased cost of flaxseed continues to be reflected in exceptional advances in linseed oil. Chicago quotes a rise of 1c.; New York 4c.; Minneapolis 8c.; Atlanta 10c.; San Francisco 15c. and Denver 16c. per gal. in 5 bbl. lots.

A total of 364 mills reporting to the National Lumber Manufactures' Association for the week ending February 11 show 680,379,215 ft. cut; 646,346,937 ft. shipped and orders for 682,979,023 ft. Production is about 25 per cent, orders 25.5 per cent and shipments 29 per cent below normal. Orders equal production; shipments are below.